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PRINCIPLES OF TAXATION.

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I.—THE COMPARATIVELY RECENT TAX EXPERIENCES OF THE FEDERAL GOVERNMENT OF THE UNITED STATES.

BEFORE passing to the detailed consideration under proper and consecutive subdivisions of the above subject, the writer thinks it expedient to outline briefly the exceptional circumstances under which his studies and investigations have been prosecuted; inasmuch, as apart from any expectation of consequent intelligent criticism on his conclusions, a somewhat personal narration may help to a better popular understanding of a great chapter in the nation's fiscal experience, which, although without a parallel in all history, has thus far received scant notice and little appreciation on the part of economic writers and historians.

His first connection with economic and fiscal questions of public import was through the publication, at the darkest financial period of the war—1864—of the results of an inquiry into the resources and prospective debt-paying ability of the United States, and bearing the title of Our Burden and Our Strength. This essay, although first printed privately, was reprinted and circulated by the Loyal Publication Society of New York, and, receiving the approbation of the Government, became one of the current publications of the war period. Reprinted in different sections of the country by loyal citizens, and also in repeated instances in England, translated into French and German, it attained a very large circulation; in excess of two hundred thousand copies. Coming also at a period when the nation was beginning to be alarmed at the magnitude and prospective increase of its

public debt, and apprehensive of an impending crushing burden of taxation, its publication and circulation was instrumental in restoring public confidence and maintaining the credit of the Government.

The attention of President Lincoln having been attracted to this publication, he invited the author in early February, 1865, to come to Washington and confer with him and Mr. Fessenden, then Secretary of the Treasury, on the best methods of dealing, after the termination of the war (then evidently near at hand), with the enormous debt and burden of taxation that the war had entailed upon the nation.* The result of this conference was, that an amendment was added, at the last hours of the Thirty-eighth Congress, to a bill "To provide Internal Revenue," and passed March 3, 1865, authorizing the Secretary of the Treasury "to appoint a commission of three persons to inquire and report at the earliest practical moment on the subject of raising by taxation such revenue as may be necessary to supply the wants of the Government, having regard to and including the sources from which such revenue should be drawn, and the best and most effectual mode of raising the same." The commission was further empowered "to inquire into the present and best methods of collecting the revenue," and to take testimony. Of this commission the writer was, unexpectedly to himself, appointed chairman by the then Secretary of the Treasury—Hon. Hugh McCulloch—after the assassination of the President, but in accordance with his previously indicated wishes.† It was also deemed expedient that, of the other members, one should be a representative of the agricultural interests of the West, and the third a citizen of Pennsylvania, the chairman being at the time a citizen of New York; and in accordance with this view Mr. S. S. Hayes, who had distinguished himself as Comptroller of Chicago, and Mr. Stephen Colwell, of Philadelphia, a gentleman of advanced age, and a successful manufacturer of iron, who had written some years before the

* Mr. Lincoln opened the conference by remarking that, although the war was evidently drawing to a close, he feared that great difficulties were yet to be encountered through the possible unwillingness or inability of the nation to pay the war debt, or the great increase in taxation which the war had made necessary; and followed this remark by asking if the writer had anything to suggest on the subject. The offhand answer returned was, that the best thing to be done was to have an examination made by competent persons of the resources of the country and the best methods of making them available for meeting the expenses of the Government through taxation. Turning to the Secretary of the Treasury, Mr. Lincoln remarked: "That's a pretty good idea, Fessenden, isn't it? We'll think about it"; and as the hour (evening) was becoming late, the conference substantially soon ended.

† The appointment was unsolicited and unexpected, and Mr. Fessenden some years afterward stated that when the composition of the commission was under consideration Mr. Lincoln remarked that "he thought we had better let the young man who had suggested the idea of it be at the head of it."

war an able book entitled Ways and Means of Payment, a Full Analysis of the Credit System, were selected. A word of retrospection is here essential to an understanding of the situation.

If it be an axiom in political and social as well as physical and natural science, that the first requisite for progress consists in the correct observation and recording of phenomena, whereby old laws or principles may be verified or extended and new ones discovered, it would be difficult to imagine a field more fruitful for investigation and more promising of reward than the financial and industrial experiences of the United States immediately anterior and subsequent to the outbreak of the civil war—experiences which had truly the character of vast social and political experiments, made on a scale of magnitude rarely if ever before equaled; for the most part emphatically tentative in character, and affecting in their results not only the growth, the income, and the industrial pursuits of the nation directly and immediately concerned, but also in a greater or less degree the trade and commerce of the whole world.

At the breaking out of the civil war in 1861, the United States was in the anomalous position of a great nation practically unencumbered with a national or public debt. Excise, stamp, income, license, and direct or general property taxes under the Federal Government were *absolutely* unknown; the expenses of a simple and economical administration being defrayed almost entirely by indirect taxes, levied in the form of a tariff on the importation of foreign products or merchandise. In fact, the only other noticeable source of national revenue was from the sale of public lands, which, at a maximum price fixed by law of one dollar and a quarter per acre, returned to the Treasury an average income of from one to three millions of dollars per annum; rising in a few instances, during periods of wild speculation to six, fourteen, and in one exceptional year (1836) to even twenty-four millions of dollars.

The average rate of duties imposed on the aggregate value of foreign importations during the thirty years immediately preceding 1860 was about twenty per cent; but for a portion of the time the annual rate was much less, and for a number of years—1834, to 1843 and 1858 to 1861 inclusive—it was not in excess of fifteen per cent.

But notwithstanding these limitations on the sources and amount of income, the requirements of the national Government for all purposes were so moderate that the receipts of its Treasury continually tended to exceed its disbursements; and the difficulty which most frequently presented itself to its financial administrators, was not the customary one in all other countries, of how to avoid an annual deficit, but rather how to manage to escape an

inconvenient but inevitable surplus. And it is a curious fact, and one perhaps altogether unprecedented and almost unrecognized in history, that from the years 1837 to 1857 there was rarely a single fiscal year, in which the unexpended balance in the national Treasury—derived from a few sources—at the end of the year, was not in excess of one half of the total expenditure of the preceding year.*

To provide for the use, or rather to get rid of a continual surplus, various plans were from time to time suggested. In one instance the House of Representatives, on motion of Henry Clay (the leading statesman of his day), seriously considered the question of the expediency of the national Government becoming by purchase and investment a partner in various stock corporations or enterprises; and pending any conclusion the surplus funds were deposited in the local or small State banks, with reiterated injunctions *"to loan liberally to merchants."*

In 1836, the unexpended cash balance in the Treasury of the United States reported as available for public purposes, being $65,723,959—$46,001,467 of which was on deposit in ninety-one different State banks—Congress (by act of June 23d of that year) appropriated the sum of $37,468,859 for distribution among the States; of which $27,063,430 was officially certified in September, 1837, as having been actually paid. Most of the States applied the amount apportioned to them for educational purposes. Others used it differently and less wisely: Massachusetts, for example, dividing her share proportionally among her towns and cities, where it was expended at the discretion of the local authorities; in one instance, in a small fishing town, for the construction of walks on the sands for the benefit of pedestrians; and in others for the purchase of houses and lands for the use and settlement of the town's poor.

As might have been expected under such circumstances, fiscal and economic subjects were during the period under consideration, those that least of all attracted the attention of the American people. Few books or essays on such topics were either written or read, while the continually increasing agitation and interest respecting the existence or extension of negro slavery furnished

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* During the decade from 1821 to 1831 the average ordinary annual expenditures of the United States were $12,390,000, or at the rate of $1.07 *per capita* of its whole population.

From 1831 to 1841, $24,740,000, or $1.61 *per capita*.

From 1841 to 1851, $33,760,000, or $1.63 *per capita*.

From 1851 to 1861, $57,870,000, or $2.06 *per capita*.

For the year 1894 the total expenditures of the Federal Government, as officially reported, were $442,605,758, or $6.08 *per capita* of the entire population of the country; or $4.50 less expenditure for pensions.

the never-ending and predominant theme for discussion alike to the press, the politicians, the pulpit, Congress, and the local legislatures. There had been, indeed, fierce discussions and political divisions in 1836–'38 respecting the organization and management of banks, and the establishment of a national bank; and in 1840–'41 and 1846, respecting the construction and adjustment of the tariff, and the principles of free trade and protection. But during the decade from 1850 to 1860 all of these questions were generally regarded as old-time issues, and by the generation that then had control of the business and government of the country were both substantially ignored and forgotten; and it was during the latter years of this period, or from 1851 to 1860, that the comparative growth and progress attained by every department of American trade, commerce, and industry was greater than for any corresponding period either before or since, in the history of the nation. During the same decade the increase in population of the country was returned at 35·59 per cent, its increase in wealth at 126·4 per cent, and the average of property to each individual at $510. In short, it would be difficult to find a more happy illustration of the influence of the "noninterference" or "nonobstructive" policy of a government with the trade, commerce, and industry of a highly civilized and active people, than the condition of the United States at that time afforded.

That the country, viewed from a politico-economic standpoint, was at this time in all respects what it should or might have been, is not, however, asserted. The institution of slavery, denying to over four millions of human beings the freedom of the person, the right to real property, and the blessings of education, was tolerated and supported by law. The paper and ordinary currency of the country, neglected by the General Government, and issued by local banks under almost as many different systems as there were States in the Union, was as defective as could be well imagined, and often necessitated a rate of exchange between the different sections of the country which was equal to or in excess of the current rates of interest at the principal commercial centers.

But notwithstanding these drawbacks the people in general were highly prosperous. Pauperism, apart from the large cities, was almost unknown; wealth was very equitably distributed; while the opportunities for elementary education were free, and in all the more densely populated portions of the country amply provided. In short, the prosperity of the people was so great, through the utilization of their natural resources, their activity, and the continued influx of the population and capital of other countries, that it constituted in itself an obstacle to reform; and the nation at large may be said to have actually preferred to en-

dure the various economic and social evils incident to their situation rather than devote time to their consideration and meet the grave political issues consequent upon any change or reformation. What would have happened? what would have been the economic and social condition of the United States, had not the people of its southern section appealed to the arbitrament of the sword in the matter of slavery and consented to its peaceful abolition,* constitutes a most curious and interesting theme for speculation. Certainly it would have been something without precedent in the world's former experience.

It was with such antecedents and under such conditions, that the nation found itself in the early months of 1861 suddenly and unexpectedly involved in a gigantic civil war, in which its very existence was threatened by the uprising of at least a third of its population against the legitimate and regularly constituted Government. The most urgent and important requirement of the Federal Government at the outset was revenue. Men in excess of any immediate necessity volunteered for service in the army, but to equip and supply even such as were needed precipitated an avalanche of expenditure upon the Treasury. To meet these financial requirements there was on the part of the Government neither money, credit, nor any adequate system of raising revenue by taxation; the previous reliable supply of revenue from the customs having at the most critical period, through the diminution of imports consequent upon the political disturbances, become subject to a serious and ominous impairment; while the money returns from all sources, other than loans, for the year 1862 were only $2,867,057. For this latter year the total ordinary receipts of revenue of the Government were but $51,919,000, and its expenditures $456,379,000.

At the outset it was assumed that the war would be short, and that the expenditures of the Government could be met by the agency of loans and an issue of paper money, the detailed history of which, although not yet familiar to the American public, is not directly pertinent to the subject under consideration, and would require a separate essay for its presentation in any degree of fullness. All direct or internal taxation was accordingly for a time avoided; there having been apparently an apprehension on the part of Congress that inasmuch as the people had never been accustomed to it, and as all machinery for assessment and collection was wholly wanting, its adoption would create popular discontent, and thereby interfere with a vigorous prosecution of hostilities. Congress accordingly confined itself at first to the

* Subsequent events have made it clear that with the continuance of slavery the development of the nation must have been greatly retarded.

enactment of measures looking to an increase of revenue from the increase of *indirect* taxes upon imports, and it was not until four months after the actual outbreak of hostilities that a *direct* tax of twenty million dollars was apportioned among the States, and an income tax of three per cent on all incomes in excess of eight hundred dollars was authorized, the first being made to take effect practically *eight* and the second *ten* months after date of enactment. Such laws, of course, became operative in the loyal States only, and produced but comparatively little revenue; and although the sphere of taxation was soon extended, the aggregate receipts from all sources by the Government for the third year of the war—from excise, income, stamps, and all other internal and direct taxes—was less than forty million dollars, and that too at a time when the expenditures were in excess of sixty million dollars per month, or at the rate of more than seven hundred million dollars per annum. And as showing how novel was this whole system of direct and internal taxation to the people, and how completely the Government officials were lacking in all experience in respect to it, the following incident may be cited: The Secretary of the Treasury in his report for 1863 stated that with a view of determining his resources he had employed a very competent person, with the aid of practical men, to estimate the probable amount of revenue to be derived from each department of internal taxation for the current year. The estimate arrived at was eighty-five million dollars, but the actual receipts were less than forty million—$37,640,787.

The people of the loyal States were, however, more determined and earnest in respect to this matter of taxation and revenue than were their rulers, and everywhere the one opinion expressed was, that taxation in all its forms should immediately, and to the largest extent, be made effective and imperative. And Congress, spurred up by and rightfully relying on public sentiment to sustain its action, at last resolutely took up the matter, and devised, or rather drifted into, a system of internal taxation which for its universality and peculiarities has no parallel in anything which had theretofore been recorded in civil history, or is likely to be thereafter.

The great necessity of the situation was revenue, and to obtain it speedily and in large amounts through taxation was the only principle recognized (if it can be called a principle), and was akin to that recommended to the traditionary Irishman on his first visit to Donnybrook Fair: "Wherever you see a head, hit it!" Wherever you find an article, a product, a trade, a profession, a sale, or a source of income, tax it! And so an edict went forth to this effect, and the people cheerfully submitted. Incomes under five thousand dollars were taxed five per cent, with an exemption

of five hundred dollars and house rent actually paid. Incomes in excess of five thousand dollars and not in excess of ten thousand dollars were taxed two and a half per cent in addition, and incomes over ten thousand dollars, five per cent additional, without any allowance or exemptions whatever. Nearly every industrial product was taxed. Cotton was taxed at the rate of two cents per pound; salt, six cents per hundred pounds; tobacco, from fifteen to thirty-five cents per pound; cigars, from three to forty dollars per thousand; sugar, from two to three cents and a half per pound. Distilled spirits were taxed progressively; first at twenty cents, and finally at two dollars per proof gallon.

But the most curious and complex taxes were those imposed on the various products of what may be termed ordinary manufacturing industry—a tax, by intent or construction, being first imposed on the raw material, and then on the total or increased value, according to circumstances, of each successive stage of its elaboration up to the finished product. And, as if this was not enough, every manufacturer was compelled to take out an annual license, while the goods produced, if sold by dealers or agents independent of the manufacturers, were subject to an additional tax of one tenth of one per cent, reckoned upon the amount of sales. This tax upon manufactures and products, with the exception of a few articles, was at first fixed, in 1864, at an average of *five* per cent; but in 1865 the rate was increased *twenty* per cent, making the tax for most articles *six* per cent.

Under the operation of this system the Government actually levied and collected on many articles of finished industrial products a tax of six per cent, the effect of which may be thus illustrated: Many manufacturing establishments sold products annually to three times the amount of their invested capital. If the capital invested was one hundred thousand dollars and the sales three hundred thousand, the tax on that business was eighteen thousand dollars, or eighteen per cent on the cost of the establishment.

The sales of its products by a manufacturing establishment are, however, no indication of its profits. It may make and sell to the amount of a million dollars without making a dollar of profit, but that, under the law, was no reason for the nonassessment and noncollection of a tax of sixty thousand dollars on the value of the product represented by its sales.

Again, the effect of the tax on every stage of elaboration of a manufactured product may be illustrated by a great variety of actual examples. Thus, in the case of the manufacture of umbrellas and parasols, it was shown that separate taxes were paid, first, on the sticks or supporting rods; then upon the handles, if carved or turned separately, of bone, wood, or ivory; then, in like

manner, upon the brass runners, the tips, the ribs, the cloth composing the cover, the elastic band which fastened the cover when closed, the rubber of which the band was composed, the button to which it was attached; and finally upon the umbrella itself, when the separate parts were aggregated, and thereby converted into a finished product. And if any of the constituents of the umbrella —as the ivory, the silk, or the metal—were of foreign production, the same were subjected on coming into the country to an import duty in addition.

In the case of books and pamphlets, it was proved by the New York Publishers' Association that, including the license and income taxes, the finished book and its constituent materials paid from fifteen to twenty separate and distinct taxes before it came to the reader—the paper and its constituents, the cloth, the glue, the starch, the leather, the slaughtered animal whence the hide furnishing the leather was obtained, the dyes with which the cloth or leather was colored or stained, the thread, the gold leaf, the type metal, the type, and the printing machinery; and then, when the whole was combined, the finished book paid an additional tax of six per cent, which was levied not upon the cost of manufacture but upon the price at which the book was sold. In addition to all these taxes, the manufacturer or publisher paid for the privilege of doing business an annual license tax, and an income tax of from five to ten per cent on his profits, if he had any.

In short, it was as if a frontier line had been drawn about each individual article or product in the nation, across which nothing could pass without being submitted to an exaction.

Besides these taxes on manufactured products of the character specified, a tax of from three to six per cent was imposed on repairs when the value of the article repaired was increased by the reason of the repairs to the extent of ten per cent; and a further tax of six per cent on what was termed "increased values," or the additional value given to any article, which had either paid an import or internal tax, by being "polished, painted, varnished, waxed, gilded, oiled, electrotyped, galvanized, plated, framed, ground, pressed, colored, dyed, trimmed, or ornamented."

The examples of difficult and nice adjudication experienced in enforcing these two classes of taxes are so curious as to justify somewhat more than a passing notice. Thus, if a worker in tin or iron made a stove at one hour and in the next hour repaired a stove to the extent of more than ten per cent of its value, he paid on the product of his *first* hour's work a tax of six per cent, and on his *second* three per cent. In like manner, a blacksmith making a taxable article, and then repairing one exactly like it, was liable to the payment of the two classes of taxes; and the theory of the law, furthermore, was that both the tinsmith and the blacksmith

kept a separate and distinct account of their different transactions. Again, if a worker in wood repaired a wheelbarrow worth one dollar, and by so doing added ten cents to its value, the increased value was taxable. But if, on the other hand, he repaired a carriage or pianoforte worth five hundred dollars, no tax accrued unless the value of the repairs exceeded ten per cent, or fifty dollars. The following absurd case was presented for adjudication under these statutes:

A wheelwright repaired a carriage to the extent of eight per cent. The owner then passed it successively to a blacksmith, a painter, and an upholsterer, neither of whom added repairs to the extent of ten per cent, or knew the value of previous repairs or the value of the carriage before it was repaired. The question then was, shall the repairs, however extensive, go untaxed, or shall the owner be taxed? The construction of the law was, that the tax must be assessed on the manufacturer, or persons receiving pay for the work, and that the owner could not be the manufacturer unless he furnished the materials, in whole or in part, for making the repairs; and then the further question arose, whether the subject of repair in the shape of the old carriage furnished by the owner was a material for making the repair, and thus constituted the owner a manufacturer, and as such liable to taxation.

In another case the question came up whether the publishers residing in one assessment district and having their books printed and bound by contract in another, were to be regarded as manufacturers of the books; or whether the printers and binders who executed the work were to be so regarded and taxed. And in two instances, in two contiguous districts in the State of Massachusetts, the law was interpreted in both ways, or in one way in one district and another way in another district; and the parties interested submitted rather than incur the trouble and expense of contesting the matter before the courts.

In fact, it is safe to say that no more complicated and absurd questions have ever seriously occupied the minds of educated men since the discussions of the schoolmen in the eleventh and twelfth centuries (as, for example, as to how many angels could stand at once on the point of a fine needle), than were evolved from the tax system of the United States during and for some time after the war period.

We have said that the people of the United States submitted to such a system. They did more. For such was the fervor of patriotism and the determination to push the war to a successful issue, that they rejoiced in it; and during the continuance of hostilities there was no movement or protest against the system which found any notable response among the masses. The country was

rich, and its accumulated resources had not for two generations been subjected by either the national or state governments to extraordinary taxation. Wealth, moreover, was very uniformly distributed, and the people pointed with pride to the annually increasing receipts of revenue under the new system; which, starting with $41,000,000 of internal revenue in 1863, rose rapidly to $117,000,000 in 1864, $211,000,000 in 1865, and culminated in 1866 with the large sum of $310,000,000, making the total revenue for that year, drawn from all sources by so-called taxation, $559,000,000, the largest sum previously contributed in any one year for the support of any Government by the free consent of its people.

So long, moreover, as the war lasted, the attempts to evade taxation by illicit methods were exceptional and in amount inconsiderable. The demand for most manufactured and agricultural products, owing to the enormous consumption of the armies and the withdrawal of labor from its accustomed vocations by enlistments, was fully equal to or in excess of supply. Prices rose rapidly with every increasing taxation or additional issues of paper money,* and under such circumstances the fiscal requirements of the war were not regarded by the majority of producers as oppressive. But, on the contrary, counting the taxes as elements of cost and reckoning profit as a percentage of the whole cost, it was generally the case that the aggregate profits of the producer were actually enhanced by reason of the taxes, to an extent considerably greater than they would have been had no taxes whatever been collected. Indeed, it was not infrequently the case that the manufacturers themselves were the most strenuous advocates for continued and rapidly increasing taxation, with a view of realizing thereby, through an advance in prices, large additional profits on products, or constituents of products, previously assessed or imported at lower rates of (customs) duties, and to bring about such advances influence and money were used without scruple.

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* Among the absurd theories put forth in justification of an extravagant issue of (irredeemable) paper money was a favorite one, that such a policy was a matter of necessity to make money easy, in order that the securities (bonds) representing Government loans should be easily floated; the one uppermost idea in the heads of the Government officials having been, apparently, that in the floating thus contrived, the bonds *alone* would possess the property of buoyancy. But in this they were mistaken. The bonds indeed floated, but everything else floated with them; or, to borrow the language of a writer of the period (who criticised this experience from the humorous point of view), "the bonds were floated, but by just about the same operation as that by which things are floated in the suburbs of a town or city submerged in a heavy freshet—hencoops floated, cellars floated, streets floated, barge houses and outhouses floated, stray children and first floors floated, all creation floated and floated together." The market for five-twenties was made easy, the market for flour, beef, cotton, and military stores, of which the Government was compelled to purchase immense quantities, was made particularly easy. The whole country was put under water and remained so for a considerable period after the war terminated.

Thus, in the case of distilled spirits, the taxation was advanced in successive years from twenty cents per gallon to sixty cents, next to a dollar and fifty cents, and finally to two dollars per gallon, and in each of these instances, and particularly after the imposition of the first two and lowest rates, the distillers and speculators reckoned, with a great degree of certainty, that a further large advance would be enacted, and that the new law would not be made retroactive or applicable to spirits distilled and assessed previously and at lower rates. In this they were not disappointed, for Congress, under the influences to which it was subjected, did virtually legislate in each instance in the manner expected, and thus gave occasion for the realization of profits in strict conformity with law by the holders of stocks made in anticipation of the several advances, which can not be estimated at a less aggregate than one hundred millions of dollars. Thus, the evidence before the United States Revenue Commission in 1865–'66 showed that there was on the 1st of January, 1864, a stock of tax-paid distilled spirits, made in anticipation of an increased tax, sufficient to meet all the requirements of the country for a period of six months, and on each gallon of this quantity, a profit or revenue, which did not accrue to the Government, of from sixty cents to a dollar and forty cents per gallon was realized. And yet, with this lesson of costly experience before it, the Fifty-third Congress, in advancing the tax on distilled spirits from ninety cents to a dollar and ten cents per gallon, afforded again such facilities to distillers and speculators, for anticipating such advance, as to legislate into their pockets at least ten millions of dollars.

In the case of cotton, which advanced mainly by reason of conditions affecting its production or distribution, it was shown by actual calculation, in respect to one manufacturing corporation in New England, that if they had at the commencement of the war burned their mills, lost their insurance, and sunk their capital other than was invested in cotton, and had subsequently sold their cotton at the highest price obtainable in place of manufacturing it, the result would have afforded to the stockholders an annuity of at least *twelve* per cent on their original investments.

How much the cost of the war and its expression in the form of debt, were unnecessarily increased by this state of affairs, has not until very recently been taken into account by writers on the fiscal history of this period, and probably can not be accurately estimated. But the following data throw great light on the subject: Thus, assuming the general average of prices in the loyal States of the Union before the war, or, more precisely, in 1860, at 100, the average from 1860 to 1865 was 186·71. But for the last year of the war, or in 1865, it was 216·81, and it was during this

latter period of greatest increase in prices that the heaviest purchases were made by the Government on account of munitions and supplies. The increased cost of the war by reason of this increase in the price of commodities, which in turn may be in a great degree attributed to the use of irredeemable paper money invested with legal-tender quality, has been estimated * at over a thousand millions of dollars, and the interest on this increased cost, another equal sum. By so much, furthermore, as these supplies and other necessaries of life were increased in price through the depreciation of the currency, those who rendered personal service in the army and navy were deprived of what ought to have been the purchasing power of the payments made to them by the Government for such service.

NEW EVIDENCE OF GLACIAL MAN IN OHIO.

By Prof. G. FREDERICK WRIGHT.

THE doubt which lingers in the minds of many concerning the sufficiency of the evidence for the existence of man in America during the Glacial period is so great, and has been so industriously fomented in certain quarters, that special interest has been manifested in a fresh discovery recently brought to light in Ohio. The discovery consists of a chipped chert implement, one inch and three quarters long and three quarters of an inch wide in its broadest part, with a projecting shoulder upon one edge, giving to it the character of what, in aboriginal usage, would be called a knife. The implement was found a mile and a half below Brilliant Station on the Ohio River, six miles from Steubenville, Ohio. In view of recent doubts upon the subject, it is necessary to give special attention to the evidence in three particulars: 1. The competence and character of the discoverer. 2. The facilities for noting the undisturbed condition of the gravel in which the implement lay. 3. The evidence that the gravel is of glacial age.

1. *The Competence and Character of the Discoverer.*—Mr. Sam Huston, the discoverer, is a graduate of the Scientific Department of Washington and Jefferson College, and has for twenty years or more been the county surveyor of Jefferson County, Ohio, residing at Steubenville. Having charge of the public improvements of the county, especially of the construction of the turnpikes, his familiarity with the topography, and especially with the gravel deposits along the river terraces, extensively resorted to for road-

* Edward Atkinson.

building and ballast for railroads, is as intimate as it is possible for any one's to be. But in connection with the engrossing occupa-

FIG. 1.—TALUS REMOVED, SO AS TO SHOW THE ORIGINAL CONDITION OF THE PIT A FEW FEET BACK FROM THE PLACE WHERE THE IMPLEMENT WAS FOUND, WHICH IS MARKED BY A *.

tions of his public business, Mr. Huston has maintained his love for pure science, and his valuable aid has been solicited by numerous scientific men engaged in making paleontological collections. It was Mr. Huston who discovered for Prof. Samuel H. Scudder the fossil insects of the coal measures which attracted so much attention two or three years ago. Prof. Cope has likewise been greatly indebted to Mr. Huston for fossils collected by him in the neighborhood of Steubenville. The evidence, therefore, is not that of either an unknown or an inexperienced observer.

2. *The Discovery.*—This I will give in Mr. Huston's own language, written out for me at my request.

"PROF. G. F. WRIGHT. "STEUBENVILLE, OHIO, *August 13, 1895.*

"MY DEAR SIR: Below Brilliant, Jefferson County, Ohio, is a very fine remnant of high-level river terrace. Its length is two miles and maximum width over a quarter of a mile. On the West Virginia side of the Ohio River at that point the bluffs rise to a

height of over three hundred feet, directly from the water at ordinary level. On the Ohio side there is a flood-plain from fifty to one hundred yards wide and from twenty to thirty feet above low water. Along the west side of this flood-plain is located the river division of the Cleveland and Pittsburg Railroad, along the foot of the high-level terrace. This terrace ranges from sixty-five to eighty feet above low water. Excavations in this terrace to a depth of forty-three feet show it to consist of interstratified sand, fine gravel, and clay in small quantities, all with rare exceptions cross-bedded. Coarse gravel is found at the top of the terrace; but, except for two or three feet on top, only rare pieces of gravel occur of more than one half cubic inch in size. Two small ravines cut through the terrace at Brilliant. A mile below these, Block House Run, and a mile and a half below, Riddle's Run cut through the terrace down to the flood-plain of the river. Otherwise the surface of the terrace is a plain. A half mile of turnpike was built on it, in which the original surface varied less than two feet.

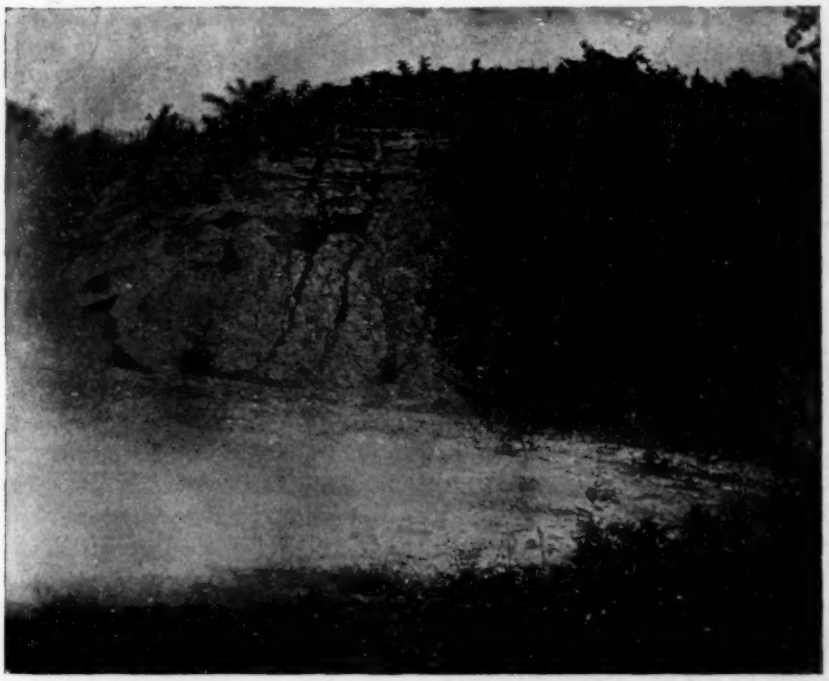

FIG. 2.—GENERAL VIEW OF THE ABANDONED GRAVEL PIT.

Indian mounds and intrusive burials occur at numerous places on the terrace, but the stratification and cross-bedding of the sands and gravels of it are such that intrusive burials or excavations can not be made without leaving evidence so distinct as to be

readily seen, and at the face of an excavation a slip or talus is easily detected.

"Over three years ago a sandpit was worked in this terrace at its southern extremity, below Riddle's Run. While the excavation was being made, and at a noon hour, I found a plainly marked but rude flint implement imbedded in the freshly exposed face of the stratified sand and gravel, under about eight feet of undisturbed cross-bedded stratification, only the point of the implement showing on the perpendicular face of the excavation. The condition of the stratification in all of the superincumbent eight feet, which was closely examined by me, was such as to convince me that the implement was not intrusive, but had been deposited with the remainder of the material of the terrace. The condition of the face of the excavation above the find is fairly, but not as clearly as would be desired, shown by the photograph taken by Mr. Doyle of the now abandoned sandpit where the find was made, where slips and talus cover the face.

"SAM HUSTON."

3. *Glacial Age of the Gravel.*—In company with Mr. Huston, Mr. Joseph B. Doyle, and Mr. Frederick C. MacClave (to whom I am indebted for the photographs and many other favors) I visited the abandoned pit where the implement was found, and studied carefully the situation, and can add my testimony to the correctness of the above description so far as it goes. But a general discussion of the questions relating to these gravel terraces is essential for the information of the general reader.

As shown in the accompanying illustration, the Ohio River occupies a narrow valley which might almost be called a gorge, which it has eroded in the nearly parallel strata of the coal measures to an average depth of about three hundred feet. This gorge is continuous from Louisville, in Kentucky, to the headwaters of the Alleghany and Monongahela Rivers, a distance of more than twelve hundred miles. All the tributaries of the river occupy gorges of similar depth. This erosion has evidently taken place with considerable rapidity consequent upon an elevation of the continent at the close of the Tertiary period, giving a steep gradient to streams which, during the most of the Tertiary period, had been very sluggish. The evidence of this is seen in the narrowness of the gorge and in the gentleness of the slope above the three-hundred-foot line.

Along the three-hundred-foot level there is a line of rock shelves which contain a shallow deposit of loam and pebbles. This is very conspicuous on the Alleghany River and for some distance below Pittsburg, but rather less so as far down as Steubenville. Still, those high-level deposits are clearly marked there

on both sides of the river. The most significant thing about these high-level terrace deposits is that they contain granitic pebbles, which are a sure indication that the deposit is postglacial; for none of the tributaries of the Ohio River have access to granite rock, except as fragments have been brought over from Canada by the glacial movement and deposited within their reach.

A sharp discussion concerning the age of the gravel upon these high rock shelves is in progress. On the one hand, Prof. T. C. Chamberlin contends that there have been two glacial periods; that the first period came on before the elevation of land which led to the erosion of the rock gorge, and that therefore this erosion is wholly interglacial, and is evidence of the lapse of an extremely long time between the two periods. On the contrary, I have maintained that the evidence of two distinct glacial periods was insufficient, and have regarded the erosion of this

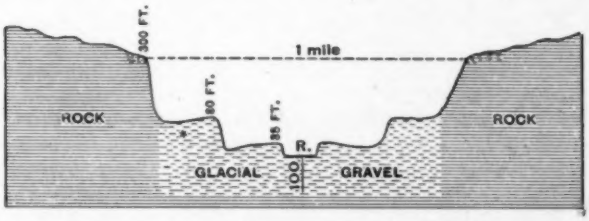

FIG. 3.—SECTION OF THE TROUGH OF THE OHIO AT BRILLIANT.
Location of the implement shown by a *.

inner rock gorge as preglacial—that is, as having been effected during the progress of that long period of late Tertiary elevation which culminated in the Glacial period. On this view of the case, the deposits of glacial gravel upon the three-hundred-foot rock shelf have been produced partly by an extensive filling up of the Alleghany gorge as far as Pittsburg and somewhat below, and lower down by the effect of the Cincinnati ice-dam, which set back the water up to this level, and is sufficient to account for many of the facts. Under this view these high-level deposits would coincide approximately with what Dana calls the "Champlain epoch," during which there was considerable depression of land at the north, the influence of which may have been felt as far south as the latitude of Pittsburg.

But whatever may be the difference of opinion about the age of these high-level gravels, there is no disagreement about the glacial character and relatively late age of the lower terraces along the Ohio River such as occur at Steubenville and Brilliant. The rock gorge extends on the average a hundred feet below the present bottom of the river, having been filled up originally by gravel not only to that extent, but to the level of the terrace in which the implement was found. That this extensive deposition

of gravel in the old rock gorge is connected with the Glacial period is clearly shown by the fact that these lower terraces can be followed up the banks of every stream which comes out of the glaciated region to the old ice border, where they emerge into the moraines which were deposited directly by the ice. This is shown in our map, on which a small portion of the glaciated area appears with Big Beaver and Little Beaver Creeks flowing out from it. The gravel terraces at Brilliant and Steubenville are shown

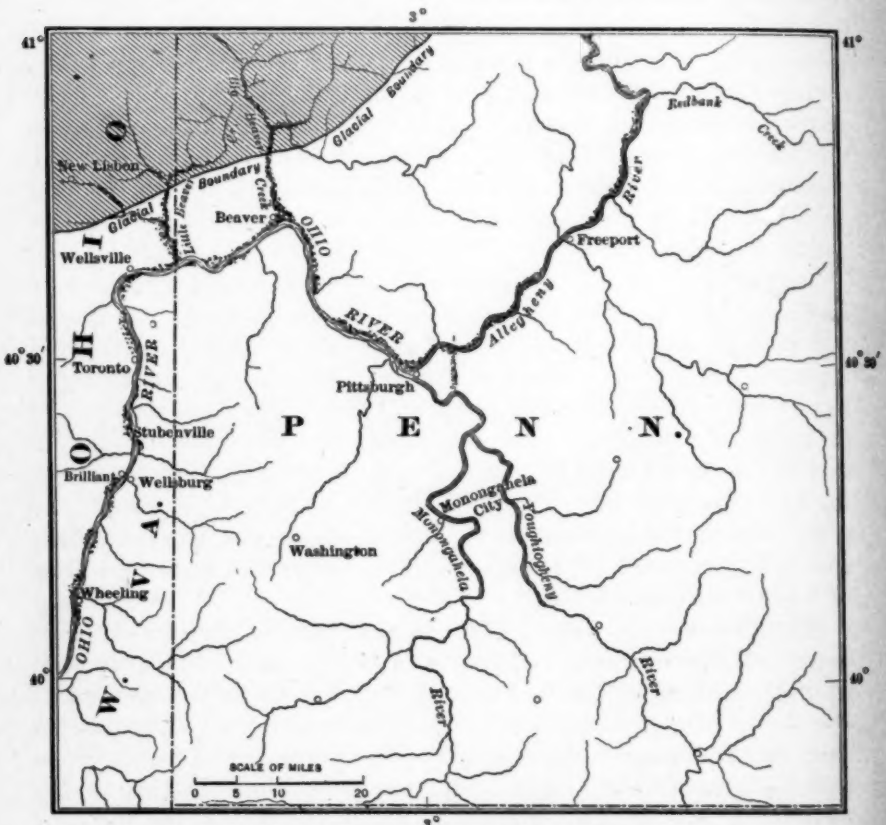

FIG. 4.—MAP OF MIDDLE OHIO RIVER REGION.
Glaciated area, shaded. Terraces shown by dots.

on this, together with other remnants of this terrace farther up the river.

Only those streams which rise in the glaciated area have such terraces. The contrast between the Monongahela and the Alleghany in this respect is very marked. The Alleghany River throughout its course was gorged with this glacial gravel, but the Monongahela River neither had the gravel within reach nor the floods of water coming from the melting ice to distribute it if it had been within reach, therefore the gravel terraces are absent.

The northern tributaries of the Ohio had both these advantages (or disadvantages), and therefore they have the terraces. On the Ohio these are always larger and higher where a tributary comes in from the glaciated region to the north, as, for example, at the mouth of Big Beaver Creek, where the terrace is a hundred and thirty feet above low-water mark. But down the river the supply of gravel diminished, and the terrace becomes correspondingly lower, being at Steubenville and Brilliant only seventy or eighty feet above low water.

I have personally examined every stream emerging from the glaciated area from the Atlantic Ocean to the Mississippi River, and can testify that everywhere substantially the same system of gravel terraces marks them as that which characterizes the Ohio and its tributaries. Without doubt they were formed during the closing stage of the period, when both great torrents of water and vast deposits of glacial *débris* were periodically released by the melting ice sheet.

So far as direct evidence is concerned in estimating the age of implements in these terraces, it relates to the question whether or not they have been found in undisturbed strata of the original terrace. If they are so found they are as old as the deposition of the gravel which took place in glacial times; for since that period of deposition the action of the present river has been confined to eroding an inner channel, such as is shown in Fig. 3, and to working over the gravel within the limits of its own flood-plain. No disturbances by present floods could affect the gravel of the eighty-foot terrace. That has remained constant from the time of its original deposition.

The direct evidence, therefore, regarding this implement would seem to be as clear and positive as it is possible to be. Relying upon the strength of this, I took the implement to the meeting of the American Association for the Advancement of Science at Springfield, Mass., in August last with great confidence. Nor was this misplaced. On being submitted, at a joint meeting of the Geological and Anthropological Sections, to Prof. F. W. Putnam, Mr. F. H. Cushing, Miss Alice Fletcher, and others, the corroborative indications of its antiquity were readily and emphatically recognized.

Prof. Putnam remarked upon the distinctness with which it retained the patina indicative of the conditions in which it is said to have been found, and said without hesitation that the implement in itself bore evidence of being a relic of great antiquity.

Mr. Cushing remarked that there could be no question that it was a finished implement, and not a "reject"; and that not only had it been finished by careful chipping all along the edge, but it had been finished twice, having been at least once resharpened

upon its cutting edge; and, what is of special significance, that it had been sharpened not by the more modern processes, described by the speaker in a previous paper, in which the chips were broken from the edge by pressing against it with a piece of bone, but by the older process of striking against the edge with another stone. The type of the implement also was pronounced by Mr. Cushing to be the earliest known, although from the convenience of the form it has always continued in use. It was one, however, which appeared at the very dawn of human development.

Thus the circumstantial evidence connected with the implement itself confirms in a remarkable degree the direct evidence respecting it. And it deserves to be placed, as it doubtless will

FIG. 5.—FACE VIEW OF THE IMPLEMENT.

FIG. 6.—FACE VIEW.

FIG. 7.—DIAGONAL VIEW OF SHARPENED EDGE.

be, among the most important discoveries heretofore made connecting man with the Glacial period.

In closing, I can not refrain from a few remarks concerning the conditions of life at that period, especially since the prolonged visits which I have made to the retreating ice front in Alaska and in Greenland have rendered it so much easier for me to believe in glacial man than it would have been without those experiences. The neighborhood of the ice border during the Glacial period was probably not an uncomfortable place in which to live. Even in Greenland, where there is no timber, the Eskimos manage to live in a great degree of comfort, and that too with no implements but those of stone and bone which they have made with their own hands. The importation of firearms and of iron implements has been of doubtful advantage to the Eskimos. From all accounts, they flourished better before their contact with Europeans than they have since.

Substantially the same may be said of the tribes in Alaska. There the conditions are in one respect even more closely similar to those which existed on the Delaware and Ohio Rivers where the remains of glacial man have been found in America. Like

southeastern Alaska, the Delaware and Ohio Valleys were densely covered with forests. Of this we have abundant evidence in the numerous trunks of trees which were overwhelmed by the advancing ice and buried in its *débris* all along the margin of the glaciated area in Ohio. It was, therefore, easily within the reach of men as intelligent as the Eskimos to maintain a comfortable existence in the valley of the Ohio when the continental glacier had expanded to its farthest extent. He did not need to resort to caverns for shelter, since the forests furnished him with the readiest means for protection.

When we reflect, also, upon the completeness with which the habitations of the modern Indian have disappeared, we need not be surprised at the total disappearance of the habitations of glacial men. Nor is it strange that well-accredited discoveries of his implements have so rarely been made in the undisturbed gravel which gives us the surest evidence of his great antiquity. Naturally, the cautious inhabitant of that time would have been somewhat careful about venturing down into the river valleys, whose terrific and periodical floods were depositing the terrace gravel, and, even though the imbedded implements were much more numerous than they are, they would be relatively so few in proportion to the great mass of material that the chances of finding one in place would be extremely small. I have looked in vain for implements in the extensive gravel pits on the Chelles and the Somme in France, and so have the majority of archæologists who have visited those famous localities. M. Reinach, the Curator of the Museum de Saint-Germain-en-Laye, has well said that one can hope personally to make discoveries of implements in place, as he would like to do, only by transforming himself into a hermit and settling down for a series of years to observe the face of the terraces where public excavations are in progress.

Meanwhile the chance discoveries by competent observers who are on the ground should be accorded their full value. Such discoveries in this country, made by Dr. C. L. Metz at Madisonville, W. C. Mills at Newcomerstown, Mr. Huston at Brilliant —all of which are well attested in Ohio—and by Dr. C. C. Abbott and Profs. Putnam, Carr, and Whitney in the glacial terrace at Trenton, N. J., form a cumulative mass of evidence which can not well be resisted. So considered, the clear testimony of the ancient chipped knife discovered by Mr. Huston at Brilliant, Ohio, must go far to close the question of man's antiquity on the western continent, and to dispel the doubts upon the subject which, for one reason or another, have heretofore existed.

STUDIES OF CHILDHOOD.

XIII.—UNDER LAW.

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(*b*) ON THE SIDE OF LAW.

IN the previous chapters we studied the child as the antagonist of law. It is evident, however, that his relation to law presents another aspect. Thus a good deal of the early criticism of parental government, so far from implying rejection of all rule, plainly implies its acceptance. Some of the earliest and bitterest protests against interference are directed against what looks to the child exceptional or irregular. He is allowed, for example, for some time to use a pair of scissors as a plaything, and is then suddenly deprived of it, his mother having now first discovered the unsuitability of the plaything. In such a case the passionate outburst, the long, bitter protest, attest the sense of injustice, the violation of custom and unwritten law. Again, the keen, resentful opposition of the child to the look of anything like unfairness and partiality in parental government shows that he has a jealous feeling of regard for the universality and the inviolateness of law. Much, too, of the criticism dealt with above reveals a fundamental acknowledgment of law—at least for the purposes of the argument. Thus the very attempt to establish an excuse, a justification, may be said to be a tacit admission that if the action *had been* done as alleged it would have been naughty and deserving of punishment. In truth, the small person's challengings of the *modus operandi* of his mother's rule just because they are often in a true sense *ethical*, clearly start from the assumption of rules, and of the distinction of right and wrong.

This of itself shows that there are compliant as well as non-compliant tendencies in the child toward law and toward authority so far as this is lawful. We may now pass to other parts of a child's behavior which help to make more clear the existence of such law-abiding impulses.

And here we may set out with those reactions of something like remorse which often follow disobedience and punishment in the first tender years. These may at the outset be little more than physical reactions due to the exhaustion of the passionate outburst. But they soon begin to show traces of other feelings. A child in disgrace, before he has a clear moral feeling of shame, suffers through a sense of estrangement, of loneliness, of self-restriction. If the habitual relation between mother and child is a

loving and happy one, the situation becomes exceedingly painful. The pride and obstinacy notwithstanding, the culprit feels that he is cut off from more than one half of his life, that his beautiful world is laid in ruins. The same little boy who said, "I'd be a worser mother," when four years and nine months old remarked to his mother that if he could say what he liked to God 'twould be, "Love me when I'm naughty." I think one can hardly conceive of a more eloquent testimony to the suffering of the child in the lonesome, loveless state of punishment.

Is there any analogue of our sense of remorse in this early suffering? The question of an instinctive moral sense in children is a perplexing one, and I do not propose to discuss it now. I would only venture to suggest that in these poignant griefs of child-life there seem to be signs of a consciousness of violated instincts. This is, no doubt, in part the smarting of a loving heart on remembering its unloving action. But there may be more than this. A child of four or five is, I conceive, quite capable of reflecting at such a time that in his fit of naughtiness he has broken with his normal orderly self, that he has set at defiance that which he customarily honors and obeys.

What, it may be asked, are these instincts? In their earliest discernible form they seem to me to be respect for rule, for a regular manner of proceeding as opposed to an irregular. A child, so I understand the little sphinx, is at once the subject of ever-changing caprices—whence the delight in playful defiance of all rule and order—and the reverer of custom, precedent, rule. And, as I conceive, this reverence for precedent and rule is the deeper and stronger, holding full sway in his serious moments.

If this view is correct, the suffering of naughty children is not, as has been said by some, wholly the result of the externals of discipline, punishment, and the loss of the agreeable things which follow good behavior, though this is commonly an element; nor is it merely the sense of loneliness and lovelessness though that is probably a large slice of it; but it contains the germ of something nearer a true remorse, viz., a sense of normal feelings and dispositions set at naught and contradicted.

And now we may ask what evidence there is for the existence of this respect for order and regularity other than that afforded by the childish protests against apparent inconsistencies in the administration of discipline.

Mr. Walter Bagehot tells us that the great initial difficulty in the formation of communities was the fixing of custom. However this be in the case of primitive communities, it seems to me indisputable that in the case of a child brought up in normal surroundings there is a clearly observable instinct to fall in with a common mode of behavior.

This respect for custom is related to the imitative instincts of the child. He does what he sees others do, and so tends to fall in with their manner of life. We all know that these small people take their cue from their elders as to what is allowable. Hence, one difficulty of moral training. A little boy when two years and one month old had happened to see his mother tear a piece of calico. The next day he was discovered to have taken the sheet from the bed and made a rent in it. When scolded, he replied in his childish German, "*Mamma mach 'put*"—i. e., *macht caput* (breaks the calico). It is well when the misleading effect of "example" is so little serious as it was in this case.

In addition to this effect of others' doings in making things allowable in the child's eyes, there is the binding influence of a repeated regular manner of proceeding. This is the might of "custom" in the full sense of the term, the force which underlies all a child's conceptions of "right." In spite of the difficulties of moral training, of drilling children into orderly habits—and I do not lose sight of these—it may confidently be said that a child has an inbred respect for what is customary and has the appearance of a rule of life. Nor is this, I believe, altogether a reflection, by imitation, of others' orderly ways and of the system of rules which are imposed on him by others. I am quite ready to admit that the institution of social life, the regular procession of the daily doings of the house, aided by the system of parental discipline, has much to do with fixing the idea of orderliness or regularity in the child's mind. Yet I believe the facts point to something more, to an innate disposition to follow precedent and rule which precedes education, and is one of the forces to which education can appeal. This disposition has its roots in habit, which is apparently a law of all life; but it is more than the blind impulse of habit, since it is reflective and rational and implies a recognition of the universal.

The first crude manifestations of this disposition to make rules to rationalize life by subjecting it to a general method, is seen in those actions which seem little more than the working of habit, the insistence on the customary lines of procedure at meals and such like. A mother writes that her boy, when five years old, was quite a stickler for punctilious order in these matters. His cup and spoon had to be put in precisely the right place; the sequences of the day, as the lesson before the walk, the walk before bed, had to be rigorously observed. Any breach of the customary was apt to be resented as a sort of impiety. This may be an extreme instance, but my observation leads me to say that such punctiliousness is not uncommon. What is more, I have seen it developing itself where the system of parental government was by no means characterized by severe insistence on such minutiæ

of order. And this would seem to show that it can not wholly be set down to the influence of such government. It seems rather to be a spontaneous extension of the realm of rule or law.

This impulse to extend rule appears more plainly in many of the little ceremonial observances of the child. Very charmingly is this respect for rule exhibited in relation to his animals, dolls, and other pets. Not only are they required to do things in a proper orderly manner, but people have to treat them with due deference.

"Every night," writes a mother of her boy, aged two years and seven months, "after I have kissed and shaken hands with him, I have to kiss his 'boy,' that is his doll, who sleeps with him, and to shake its two hands; also to shake the four hoofs of a tiny horse which lies at the foot of his cot. When all this has been gone through he stands up and entreats 'more tata please, more tata'—i. e., 'kiss me again and say more good nights.' These customs of his with regard to kissing are peculiar to himself: he kisses his 'boy' (doll), also pictures of horses, dogs, cocks, and hens, and he puts his head against us *to be kissed;* but he will only shake hands and will not kiss people himself; he reserves his kisses for what he seems to feel inferior things. We kiss our boy, he kisses his; but he insists upon being shaken hands with for his part. If other children come to play, he gives them toys, watches them with delight, tries to give them rides on his 'go-go's,' but does not kiss them; though he will stroke their hair, he does not return their kisses. It seems to me that he regards it as an action to be reserved for an inferior thing."

I have quoted at length this careful bit of maternal observation because it seems to indicate so clearly a spontaneous extension of a custom. The practice of the mother and father in kissing him was generalized into a rule of ceremony in the treatment of all inferiors.

This subject of childish ceremonial is a curious one and deserves a more careful study. It is hardly less interesting than the origin and survival of ceremonial as elucidated by Mr. Herbert Spencer and others. The respect for orderly procedure on all serious occasions, and especially at church, is as exacting as that of any savage tribe. Punch illustrated this some years ago by a picture of a little girl asking her mamma if Mr. So-and-so was not a very wicked man because he didn't "smell his hat" when he came into his pew.

This jealous regard for ceremony and the proprieties of behavior is seen in the enforcement of rules of politeness by children, who will extend them far beyong the scope intended by the parent. A delightful instance of this fell under my own observation as I was walking on Hampstead Heath. It was a spring

day and the fat buds of the chestnut were bursting into magnificent green plumes. Two well-dressed "misses," aged, I should say, about nine and eleven, were taking their correct morning walk. The elder called the attention of the younger to one of the trees, pointing to it. The younger exclaimed in a highly shocked tone, "O Maud (or was it 'Mabel'?), you know you *shouldn't* point!" The notion of perpetrating a rudeness on the chestnut tree was funny enough. But the incident is instructive as illustrating the childish tendency to stretch and generalize rules to the utmost.

The domain of prayer well illustrates the same tendency. The child envisages God as a very, very grand person, and naturally therefore extends to him all the courtesies he knows of. Thus he must be addressed politely with the due forms, "Please," "If you please," and so forth. The German child shrinks from using the familiar form "*Du*" in his prayers. As one maiden of seven well put it in reply to a question why she used "*Sie*" in her prayers: "*Ich werde doch den lieben Gott nicht Du nennen: ich kenne ihn ja gar nicht.*" Again, a child feels that he must not worry or bore God (children generally find out that some people look on them as bores), or treat him with any kind of disrespect. C—— objected to his sister's remaining so long at her prayers, apparently on the ground that, as God knew what she had to say, her much talking would be likely to bore him. An American boy of four on one occasion refused to say his prayers, explaining: "Why, they're old. God has heard them so many times that they are old to him too. Why, he knows them as well as I do myself." On the other hand, God must not be kept waiting. "O mamma," said a little boy of three years and eight months (the same that was so insistent about the kissing and hand-shaking), "how long you have kept me awake for you! God has been wondering so whenever I was going to say my prayers." All the words must be nicely said to him. A little boy aged four years and nine months once stopped in the middle of a prayer and asked his mother, "Oh, how do you spell that word?" The question is curious as suggesting that the child may have envisaged his silent communications to the far-off King as a letter. In any case it showed painstaking and the wish not to offend by slovenliness of address.

Not only do children of themselves extend the scope and empire of rule; they show a disposition to make rules for themselves. If a child that is told to do a thing on a single occasion only is found repeating the action on other occasions, this seems to show the germ of a law-making impulse. A little boy of two years and one month was once told to give a lot of old toys to the children of the gardener. Some time after, on receiving some new toys,

he put away his old ones as before for the less fortunate children. Every careful observer of children knows that they are apt to proceed this way, to erect particular actions and suggestions into precedents. This tendency gives something of the amusing priggishness to the ways of childhood.

There is little doubt, I think, that this respect for proper orderly behavior, for precedent and general rule, forms a vital element in the child's submission to parental law. In fixing our attention on occasional acts of disobedience and lawlessness we are apt to overlook the ease, the absence of friction with which normal children, if only decently trained, fall in with the larger part of our observances and ordinances.

That the instinct for order does assist moral discipline may be seen in the fact that children are apt to pay enormous deference to our rules. Nothing is more suggestive here than the talk of children among themselves, the emphasis they are wont to lay on the "must" and "must not." The truth is that children have a tremendous belief in law: a rule is apt to present itself to their imagination as a thing supremely sacred and awful before which it prostrates itself.

This recognition of the absolute imperativeness of a rule properly laid down by the recognized authority is seen in children's jealous insistence on the observance of the rule in their own case and in that of others. As has been observed by Preyer, a child of two years and eight months will follow out the prohibitions of the mother when he falls into other hands, sternly protesting, for example, against the nurse giving him the forbidden knife at table. Very proper children rather like to instruct their aunts and other ignorant persons as to the right way of dealing with them, and will rejoice in the opportunity of setting them right even when it means a deprivation for themselves. The self-denying ordinance, "Mamma doesn't let me have many sweets," is by no means beyond the powers of such a child. One can see here, no doubt, traces of a childish sense of self-importance, a feeling of the much-waited-on little sovereign for what befits his supreme worth. Yet, allowing for such elements, there seems to me to be in this behavior a residue of genuine respect for parental law.

These carryings out of the parental behest when intrusted to other hands are instructive as suggesting that the child feels the constraining force of the command when its author is no longer present to enforce it. Perhaps a clearer evidence of respect for the law as such, apart from its particular enforcement by the parent, is supplied by children's way of extending the rules laid down for their own behavior to that of others. This point has already been illustrated in the tendency to universalize the observ-

ances of courtesy and the like. No trait is better marked in the normal child than the impulse to subject others to his own disciplinary system. In truth, children are for the most part particularly alert disciplinarians. With what amusing severity are they wont to lay down the law to their dolls, and their animal playmates, subjecting them to precisely the same prohibitions and punishments as those to which they themselves are subject! Nor do they stop here. They enforce the duties just as courageously on their human elders. A mite of eighteen months went up to her elder sister who was crying, and with perfect mimicry of the nurse's corrective manner said, "Hush, hush! papa!" pointing at the same time to the door. The little girl M——, when twenty-two months old, was disappointed because a certain Mr. G—— did not call. In the evening she said, "Mr. D—— not did tum—was very naughty. Mr. D—— have to be whipped." So natural and inevitable to the intelligence of a child does it seem that the system of restraints, rebukes, punishments under which he lives should have universal validity.

This judicial bent of the child is a curious one, and often develops a priggish fondness for setting others morally straight. Small boys have to endure much in this way from the hands of slightly older sisters proficient in matters of law and delighting to enforce the moralities. But sometimes the sisters lapse into naughtiness and then the small boys have their chance. They too can on such occasions be priggish if not downright hypocritical. A little boy had been quarreling with his sister, named Muriel, just before going to bed. When he was undressed he knelt down to say his prayers, Muriel sitting near and listening. He prayed (audibly) in this wise: "Please, God, make Muriel a good girl," then looked up and said in an angry voice, "Do you hear that, Muriel?" and after this digression resumed his petition. I believe fathers, on reading family prayers, have been known to apply portions of Scripture in this personal manner to particular members of the family; and it is even possible that extempore prayers have been invented, as by this little prig of a boy, for the purpose of administering a sort of back-handed moral blow to an erring neighbor.

This mania for correction shows itself too in relation to the authorities themselves. A collection of rebukes and expositions of moral precept supplied by children to their erring parents would be amusing and suggestive. As was illustrated above, a child is especially keen to spy fault in his governors when they are themselves administering authority. Here is another example: A boy of two—the moral instruction of parents by the child begins betimes—would not go to sleep when bidden to do so by his father and mother. At length the father, losing patience, ad-

dressed him with a man's fierce emphasis. This mode of admonition, so far from cowing the child, simply offended his sense of propriety, for he rejoined, "You souldn't souldn't Assum" (i. e., "Arthur," the father's name), "you sould speak nicely."

The lengths to which a child with the impulse of moral correction strong in him will sometimes go are quite appalling. One evening a little girl of six had been repeating the Lord's prayer. When she had finished she looked up and said, "I don't like that prayer, you ought not to ask for *bread*, and all that *greediness*, you ought only to ask for goodness!" There is probably in this an imitative reproduction of something the child had had said to herself by her mother or had overheard. Yet allowing for this, one can not but recognize a quite alarming degree of precocious moral priggishness.

We may now turn to what my readers will probably regard as still clearer evidence of a law-fearing instinct in children, viz., their voluntary submission to its commands. We are apt to think of these little ones as doing right only under external compulsion. But although a child of four may be far from attaining to the state of "autonomy of will," or self-legislation spoken of by the philosopher, he may show a germ of such free adoption of law. It is possible that we see the first faint traces of this in a small child's way of giving orders to, rebuking, and praising himself. The little girl M——, when twenty months old, would, when left by her mother alone in a room, say to herself, "Tay dar" (stay there). About the same time, after being naughty and squealing "like a railway whistle," she would after each squeal say in a deep voice, "Be dood, Babba" (her name). At the age of twenty-two months she had been in the garden and misbehaving by treading on the box border, so that she had to be carried away by her mother. She had to confess her fault, wanted to go into the garden again, and promised, "Baba will not be naughty adain." When she was out she looked at the box, saying, "If oo (you) do dat I shall have to take oo in, Babba." Here, no doubt, we see quaint mimicries of the external control; but they seem to me to indicate a movement in the direction of self-control.

Very instructive here is the way in which children will voluntarily come and submit themselves to our discipline. The little girl M——, when less than two years old, would go to her mother, confess some piece of naughtiness, and suggest the punishment. A little boy, aged two years and four months, was deprived of a pencil from Thursday to Sunday for scribbling on the wall paper. His punishment was, however, tempered by permission to draw when taken downstairs. On Saturday he had finished a picture downstairs which pleased him. When his nurse fetched him, she wanted to look at the drawing, but the boy strongly objected,

saying, "No Nana (name for nurse) look at it till Sunday ."And sure enough, when Sunday came and the pencil was restored to him, he promptly showed nurse his picture. This is an excellent observation full of suggestion as to the way in which a child's mind works. Among other things it seems to show pretty plainly that the little fellow looked on the nursery and all its belongings, including the nurse, during these three days as a place of disgrace, into which the privileges of the artist were not to enter. He was allowed the indulgence of drawing downstairs, but he had no right to exhibit his workmanship to the nurse, who was inseparably associated in his mind with the forbidden nursery drawing. Thus a process of genuine child-thought led to a self-instituted extension of the punishment.

A month later this child "pulled down a picture in the nursery"—the nursery walls seem to have had a fell attraction for him—by standing on a sofa and tugging till the wire broke. He was alone at the time and very much frightened, though not hurt. He was soothed and told to leave the picture alone in future, but was not in any way rebuked. He seemed, however, to think that some punishment was necessary, for he presently asked whether he was going to have a certain favorite frock on that afternoon. He was told "No" (the reason being that the day was wet or something similar), and he said immediately, "'Cause Neil pulled picture down?" Here, I think, we have unmistakable evidence of an expectation of punishment as the fit and proper sequel in a case which, although it did not exactly resemble those already branded by punishment, was felt in a vague way to be disorderly and naughty.

Such stories of expectation of punishment are capped by instances of punishment actually inflicted by the child on himself. I believe it is not uncommon for a child, when possessed by a sense of having been naughty, to object to having nice things at table, on the ground that previously on a like occasion he was deprived of them. But the most curious instance of this moral rigor toward self which I have met with is the following: A girl of nine had been naughty, and was very sorry for her misbehavior. She was noticed coming to her lesson limping, and remarked that she felt very uncomfortable. Being asked by her governess what was the matter with her, she said, "It was very naughty of me to disobey you, so I put my right shoe on to my left foot and my left shoe on to my right foot."

The facts here briefly illustrated seem to me to show that there is in the child from the first a rudiment of true law-abidingness. And this is a force of the greatest consequence to the disciplinarian. It is something which takes side in the child's breast with the reasonable governor and the laws which he or

she administers. It secures ready compliance with a large part of the discipline enforced. When the impulse urging toward license has been too strong, and disobedience ensues, this same instinct comes to the aid of order and good conduct by inflicting pains which are the beginning of what we call remorse.

By and by other forces will assist. The affectionate child will reflect on the misery his disobedience causes his mother. A boy of four years and nine months must, one supposes, have woke up to this fact when he remarked to his mother: "Did you choose to be a mother? I think it must be rather tiresome." The day when the child first becomes capable of thus putting himself into his mother's place and realizing, if only for an instant, the trouble he has brought on her, is an all-important one in his moral development.

As our illustrations have suggested, and as every thoughtful parent knows well enough, the problem of moral training in the first years is full of difficulty. Yet our study surely suggests that it is not so hopeless a problem as we are sometimes weakly disposed to think. Perhaps a word or two on this may not inappropriately close this essay.

I will readily concede that the difficulty of inculcating in children a sweet and cheerful obedience arises partly from the nature of the child. There are trying children, just as there are trying dogs that howl and make themselves disagreeable for no discoverable reason but their inherent "cussedness." There are, I doubt not, conscientious, painstaking mothers, who have been baffled by having to manage what appears to be the utterly unmanageable.

Yet I think that we ought to be very slow to pronounce any child unmanageable. I know full well that in the case of these small growing things there are all kinds of hidden physical commotions which breed caprices, ruffle the temper, and make them the opposite of docile. The peevish child who will do nothing, will listen to no suggestion, is assuredly a difficult thing to deal with. But such moodiness and cross-grainedness springing from bodily disturbances will be allowed for by the discerning mother, who will be too wise to bring the severer measures of discipline to bear on a child when subject to its malign influence. Waiving these disturbing factors, however, I should say that a good part, certainly more than one half, of the difficulty of training children is due to our clumsy, bungling modes of going to work.

Sensible persons know that there is a good and a bad way of approaching a child. The wrong ways of trying to constrain children are, alas! numerous. I am not writing an "advice to parents," and am not called on therefore to deal with the much-disputed question of the rightness and the wrongness of corporal

punishments. Slaps may be needful in the early stages, even though they do lead to little tussles; a mother assures me that these battles with her several children have all fallen between the ages of sixteen months and two years. It is, however, conceivable that such fights might be avoided altogether; yet a man should be chary of dogmatizing on this delicate matter.

What is beyond doubt is that the slovenly discipline—if indeed discipline it is to be called—which consists in alternations of gushing fondness with almost savage severity, or fits of government and restraint interpolated between long periods of neglect and *laisser faire*, is precisely what develops the rebellious and law-resisting propensities. But discipline can be bad without being a stupid pretense. Everything in the shape of inconsistency, saying one thing at one time, another thing at another, or treating one child in one fashion, another in another, tends to undermine the pillars of authority. Young eyes are quick to note these little contradictions, and they sorely resent them. It is astonishing how careless disciplinarians can show themselves before these astute little critics. It is the commonest thing to tell a child to behave like his elders, forgetting that this, if indeed a rule at all, can only be one of very limited application. Here is a suggestive example of the effect of this sort of teaching sent me by a mother: "At three years and six months, when some visitors were present, she was told not to talk at dinner time. 'Why me no talk? Papa talks.' 'Yes, but papa is grown up and you are only a little girl; you can't do just like grown-up people.' She was silent for some time, but when I told her ten minutes later to sit nicely with her hands on her lap like her cousins, she replied, with a very humorous smile, 'Me tan't (can't) sit like grown-up people, me is only a little girl.'"

We can fail and make children disloyal instead of loyal subjects by unduly magnifying our office, by insisting too much on our authority. Children who are over-ruled, who have no taste of being left unmolested and free to do what they like, can hardly be expected to submit graciously. Another way of carrying parental control to excess is by exacting displays of virtue which are beyond the moral capabilities of the child. A lady sends me this reminiscence of her childhood: She had been promised sixpence when she could play her scales without fault, and succeeded in the exploit on her sixth birthday. The sixpence was given to her, but soon after her mother suggested that she should spend the sixpence in fruit to give to her (the mother's) invalid friend. This was offending the sense of justice, for if the child, is jealous of anything as her very own, it is surely the reward she has earned; and was, moreover, a foolish attempt to call forth generosity where generosity was wholly out of place. An even

worse example is that recorded by Ruskin: When a child, he was expected to come down to dessert and crack nuts for the grand older folk while peremptorily forbidden to eat any. Such refined cruelties of government deserve to be defeated in their objects. Much of our ill success in governing children would probably turn out to be attributable to unwisdom in assigning tasks, and more particularly in making exactions which wound that sensitive fiber of a child's heart, the sense of justice.

Parents are, I fear, apt to forget that generosity and the other liberal virtues owe their worth to their spontaneity. They may be suggested and encouraged but can not be exacted. On the other hand, a parent can not be more foolish than to discourage a spontaneous out-going of good impulse, as if nothing were good but what emanated from a spirit of obedience. In a pretty and touching little American work, Beckonings from Little Hands, the writer describes the remorse of a father who after his child's death recalled the little fellow's first crude endeavor to help him by bringing fuel, an endeavor which, alas! he had met with something like a rebuff.

The right method of training which develops and strengthens by bracing exercise the instinct of obedience can not easily be summarized, for it is the outcome of the highest wisdom. I may, however, be permitted to indicate one or two of its main features.

Informed at the outset by a fine moral feeling and a practical tact as to what ought to be expected, the wise mother is concerned before everything to make her laws appear as much a matter of course as the daily sequences of the home life, as unquestionable axioms of behavior; and this not by a foolish vehemence of inculcation, but by a quiet, skillful inweaving of them into the order of the child's world. To expect the right thing, as though the wrong thing were an impossibility, rather than to be always pointing out the wrong thing and threatening consequences; to make all her words and all her own actions support this view of the inevitableness of law; to meet any indications of a disobedient spirit first with misunderstanding and later with amazement—this is surely the first and fundamental matter.

The effectiveness of this discipline depends on the simple psychological principle that difficult actions tend to realize themselves in the measure in which the ideas of them become clear and persistent. Get a child steadily to follow out in thought an act to which he is disinclined and you have more than half mastered the disinclination. The quiet daily insistence of the wise rule of the nursery proceeds by setting up and maintaining the ideas of dutiful actions, and so excluding the thought of disobedient actions.

It has recently been pointed out that in this moral control of the child through suggestion of right actions we have something closely analogous to the action of suggestion upon the hypnotized subject. The mother—the right sort of mother—has on the child's mind something of the subduing influence of the Nancy doctor: she induces ideas of particular actions, gives them force and persistence, so that the young mind is possessed by them, and they work themselves out into fulfillment as occasion arises.

In order that this effect of "obsession," of a full occupation of consciousness with the right idea may result, certain precautions are necessary. As every parent knows, a child may be led by a prohibition to do the very thing he is bidden not to do. We have seen how readily a child's mind moves from an affirmation to a corresponding negation, and conversely. The contradictoriness of a child, his passion for saying the opposite of what you say, shows the same odd manner of working of the young mind. Wanting to do what he is told not to do is another effect of this "contrary suggestion," as it has been called, aided, of course, by the child's dislike of all constraint.* If we want to avoid this effect we must first of all acquire the difficult secret of personal influence, of the masterfulness which does not repel; and secondly, reduce our prohibitions with their contrary suggestions to a minimum.

The action in moral training of this influence of a quasi-hypnotic suggestion becomes more clearly marked when difficulties occur; when some outbreak of willful resistance has to be recognized and met, or some new and relatively arduous feat of obedience has to be initiated. Here I find that intelligent mothers have found their way to methods closely resembling those of the hypnotist. "When R—— is naughty and in a passion" (writes a lady friend of her child, aged three years and three months), "I need only suggest to him that he is some one else, say a friend of his, and he will take it up at once; he will pretend to be the other child, and at last go and call himself, now a good boy, back again." This mode of suggestion, by helping the higher self to detach itself from and control the lower, might, one suspects, be much more widely employed in the moral training of children. Suggestion may work through the emotions. Merely to say, "Mother would like you to do this," is to set up an idea in the child's consciousness by help of the sustaining force of his affection. "If [writes a lady] there was anything L—— particularly wished not to do, his mother had only to say, 'Dobbin [a sort of

* On the nature of this contrary suggestion, see Mark Baldwin, Mental Development in the Child and the Race, p. 145.

canonized toy horse already referred to] would like you to do this,' and it was done without a murmur."

We have another analogue to hypnotic suggestion when a mother prepares her child some time beforehand for a difficult duty, telling him that she expects him to perform it. A mother writes that her boy, when about the age of two years and three months more particularly, was inclined to burst into loud but short fits of crying. "I have found [she says] they are often checked by telling him beforehand what would be expected of him, and exacting a promise that he would do the thing cheerfully. I have seen his face flush up ready to cry when he remembered his promise and controlled himself." This reminds one forcibly of the commands suggested by the hypnotizer to be carried into effect when the subject wakes.

Much more, perhaps, might be done in this direction by choosing the right moment for setting up the persistent ideas in the child's consciousness. I know a lady who got into the way of giving moral exhortation to her somewhat headstrong girl at night before the child fell asleep, and found this very effectual. It is possible that we may be able to apply this idea of preparatory and premonitory suggestion in new and surprising ways to difficult and refractory children.*

One other way in which the wise mother will win the child over to duty is by developing his consciousness of freedom and power. A mother, who was herself a well-known writer for children, has recorded in some notes on her children that when one of her little girls was disinclined to accede to her wish she used to say to her, "Oh, yes, I think when you have remembered how pleasant it is to oblige others you will do it." "I will think about it, mamma," the child would reply, laughing, and then go and hide her head behind a sofa pillow, which she called her "thinking corner." In half a minute she would come out and say, "Oh, yes, mamma, I have thought about it and I will do it." This strikes me as an admirable combination of regulative suggestion with exercise of the young will in moral decision. It gave the child the consciousness of using her own will, and yet maintained the needed measure of guidance and control.

As the moral consciousness develops and new problems arise, new openings for such suggestive guidance occur. How valuable, for example, is the mother's encouragement of the weakly child shrinking from a difficult self-repressive action when she says with inspiring voice, "You *can* do it if you try." Thus, pilotlike,

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* The bearings of (hypnotic) suggestion on moral education have been discussed by Guyau, Education and Heredity (English translation), chap. i. Compare also Preyer, *op. cit.*, p. 267 f., and Compayré, *op. cit.*, p. 262.

she conducts the little navigator out into the open main of duty where he will have to steer himself.

I have tried to show that the moral training of children is not beyond human powers. It has its strong supports in child-nature, and these, where there are wisdom and method on the ruler's side, will secure success. I have not said that the mother's task is easy. So far from thinking this, I hold that a mother who bravely faces the problem, neither abandoning the wayward will to its own devices nor, hardly less weakly, handing over the task of disciplining it to a paid substitute, and who by well-considered and steadfast effort succeeds in approaching the perfection I have hinted at, combining the wise ruler with the tender and compassionate parent, is among the few members of our species who are entitled to its reverence.

THE ANATOMY OF SPEED SKATING.

By R. TAIT McKENZIE.

SPEED skating as a distinct branch of athletics is of recent date, but as an art it is one of the oldest cultivated by the vigorous nations of the temperate and frigid zones.

Fitz Stephen, the historian of London, speaks of the sport as taking place in the twelfth century, but the first mention in history occurs eighteen hundred years ago, in the Edda, where the god Uller is represented as distinguished by beauty, arrows, and skates. In 1662, Pepys enters this item in his diary under date December 1st: "So to my Lord Sandwich's, to Mr. Moore, and then over the Parke (where I first in my life, it being a great frost, did see people sliding with their skeates, which is a very pretty art)."

When we consider the improvements that modern ingenuity has added to skates and race tracks, and the modern methods of training, we would expect marked reductions in the time taken to cover the various distances. We have no means of comparing speeds for distances under a mile, but if we can trust the time taken by the watches of 1821 we may accept the fact that in England a Lincolnshire man won one hundred guineas by skating a mile within two seconds of three minutes. The present record is only four or five seconds better (2·56, Johnson, January 7, 1894).

At the beginning of the century (1801) two young women skated thirty miles in two hours at Groningen; and if we go into the dangerous ground of "hearsay" we will find an account of a father who crossed forty leagues one day to rescue his son from danger, and of another who bet that he could cover three

leagues on ice while his friend went one and a half on the best horse.

It has had among its devotees no less a man than Goethe, the great German poet, who sought by this means to drive away his persistent sleeplessness and bring back his youthful vigor. One clear, cold morning in December he is said to have jumped from his bed, strapped on his skates, and to have sallied out, reciting the following like one inspired: "Penetrated with the gayety that

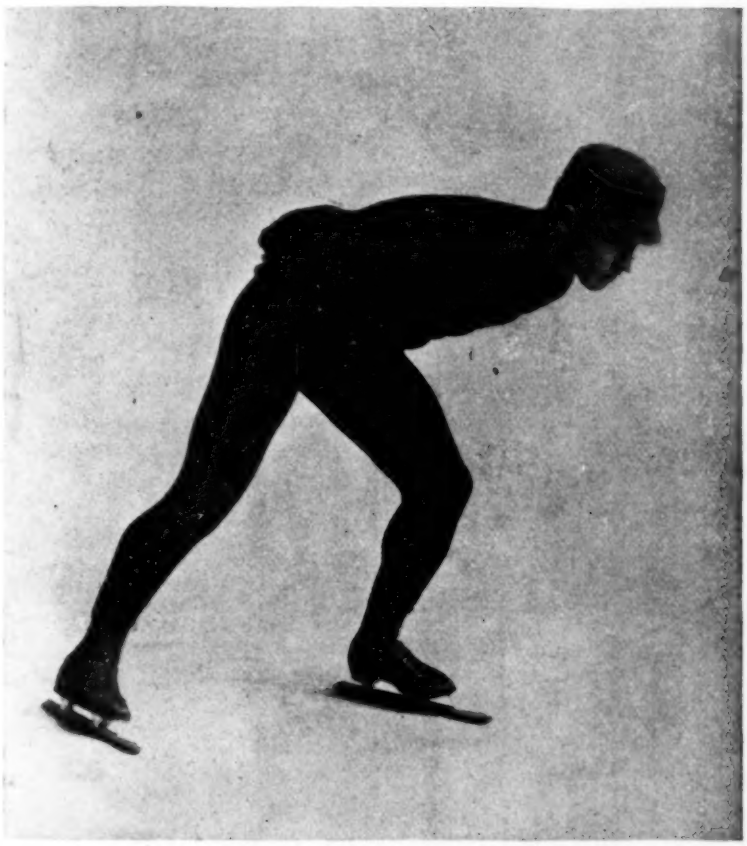

FIG. 1.—J. K. MCCULLOCH IN SKATING POSITION.

gives the feeling of health, I go to scour afar the glistening crystal. . . . How brilliant is the ice that night has spread on the waters!"

It is also said of him that when he and Klopstock the poet met for the first time—one in his prime and the other in the decline of life—the subject of conversation was not poetry, literature, or æsthetics, as we would suppose, but was entirely devoted to skating.

The prominence of athletic sports has directed much attention to the various problems that are intimately connected with their practice in their various forms, and naturally the question of the anatomical characteristics required for success in any branch of athletics is one of the first to be investigated in the light of modern physiology and anatomy.

One of the teachings of modern physiology is that function makes structure; that if horses are raced generation after gen-

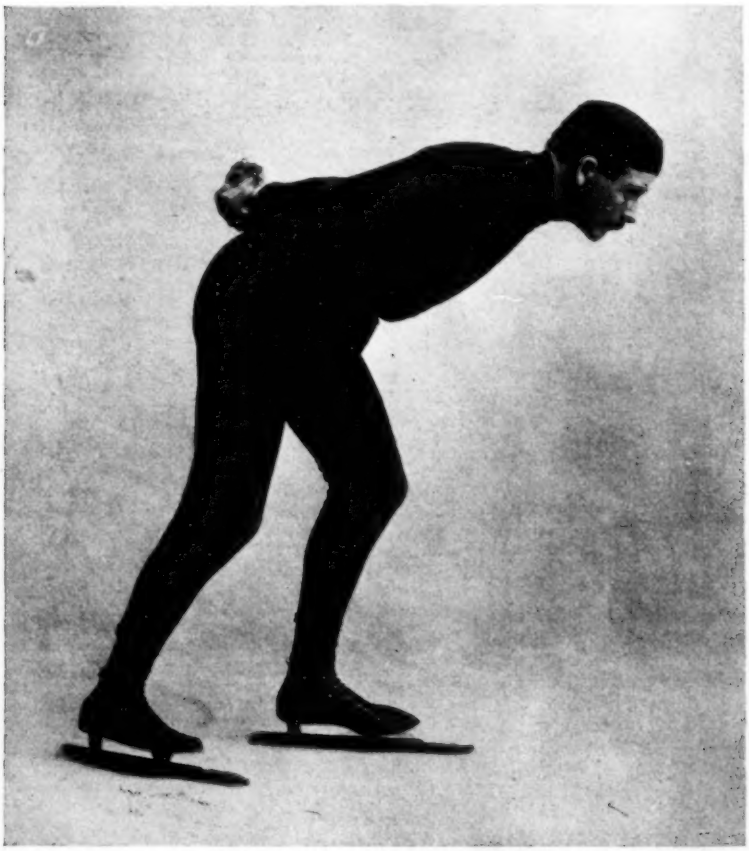

FIG. 2.—ADOLPH NORSING IN SKATING POSITION.

eration we get the slender, nervous race horse, while if they pull heavy loads we have developed the Clydesdale type. Again, if a man has to use his right hand and arm only, continuously in his work we get it large and brawny, while the rest of his muscular system may be but poorly developed. It is this specialism that gives such a law a chance of showing its workings, so that one can often pick out a man's trade by peculiarities in his physique.

In athletics, which include the severest forms of physical labor,

we would look for examples of the operation of this law, for nowhere has specialism been carried further than in athletic sports.

Such contests as the Penthalon, a revival of the Greek idea of all-around development, which includes a test in running and jumping and weight-putting, are too rare in our modern athletic meets.

Men systematically train for bicycle racing until the particular set of muscles used in that particular exercise—those of legs and thighs—are in a perfect state of development, while the arms remain poor and the chest flat.

The "bicycle stoop" is now a well-recognized deformity, and few men who have devoted much time or attention to racing are entirely free from it, while in many racers the marked dorsal curvature forward (kyphosis) is permanent, unsightly, and injurious to the health.

Heavy gymnastics were the cause of many round shoulders till a reaction took place in the world of physical education, and now body-building is done by the almost exclusive use of light work. This reaction has extended to the more intelligent athletic trainers, who have given up the old drastic methods and have adopted more rational means of obtaining strength and endurance to their *protégés*.

Our present method of testing athletic prowess thus encourages the exclusive development of certain groups of muscles and the neglect of others—sometimes, as we will see, to the permanent deformity of its too zealous votaries.

Other instances of anatomical changes brought about by special feats could be cited, such as the flat foot of the broad-jumper or the broad back and flat chest of the oarsman; but one of the best examples of this effect of function on structure is seen in "speed skating," which the international contests of the last few years have done so much to popularize.

Speed skating differs from ordinary skating in several marked particulars. The skate itself—about eighteen inches long—has a flat blade, almost as thin as a knife, set into a light tube supporting two uprights, circular but hollow. These short upright tubes fasten it to the boot by means of a plate, the whole purpose being to combine the greatest strength and lightness. The boot laces tightly, giving firm support to the ankle.

This form has evolved from the original skate, made of the lower jawbones of horses and cattle carved to the proper shape and polished. In the British Museum the visitor can still see a pair of these primitive instruments, and the workmen occasionally disinter them about Moorfields and Finsbury.

Let us take up the strengths and weaknesses of the modern

speed skaters, who, like the Homeric gods, "stride with winged feet over the sea transmuted into solid ground."

The racing posture of all the best skaters is practically the same. The back is kept straight and horizontal, the arms folded across the back except when spurting; then they are swung from side to side, keeping time to the stroke. Thighs are flexed to a right angle, while the knees are kept in half flexion or almost straight (Figs. 1 and 2). In a recent championship race five of the best amateurs in the world were strung out in line, and their rhythmical swing and stride were as if one brain was moving the whole combination. The crouching position, while it does not interfere with respiration, diminishes resistance to the wind—an important advantage—and also gives the best position for using the powerful muscles of the loins and back.

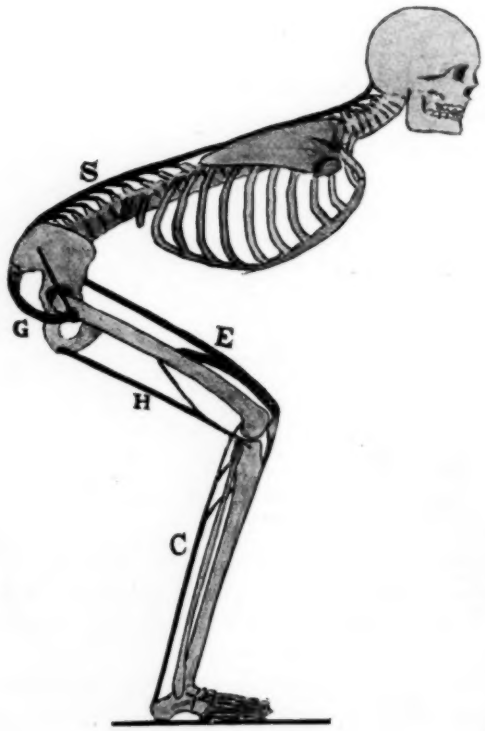

FIG. 3.—DIAGRAM.

The stroke of all the best men is practically the same, and differs from that of ordinary skating both in its direction and in the way it is taken. Its direction is more forward and backward than one from the ordinary short skate, and with the long, flat blade the stroke is given by the whole of the foot flat. Any lifting of the heel in striking out is impossible on account of the length of skate-blade. This has an important bearing on muscular development, as will be seen later.

The muscles most used in speed skating will be seen by the accompanying diagram, in which muscles are represented by the heavy black lines. A stroke is made by extending the knee and hip joints, and the erector spinæ muscles (S) are brought into strong action in straightening the back on the pelvis, which is thereby made firm enough to resist the action of the muscles of the lower limb. The powerful gluteal muscles (G), which in standing keep the body in the upright position, contract strongly,

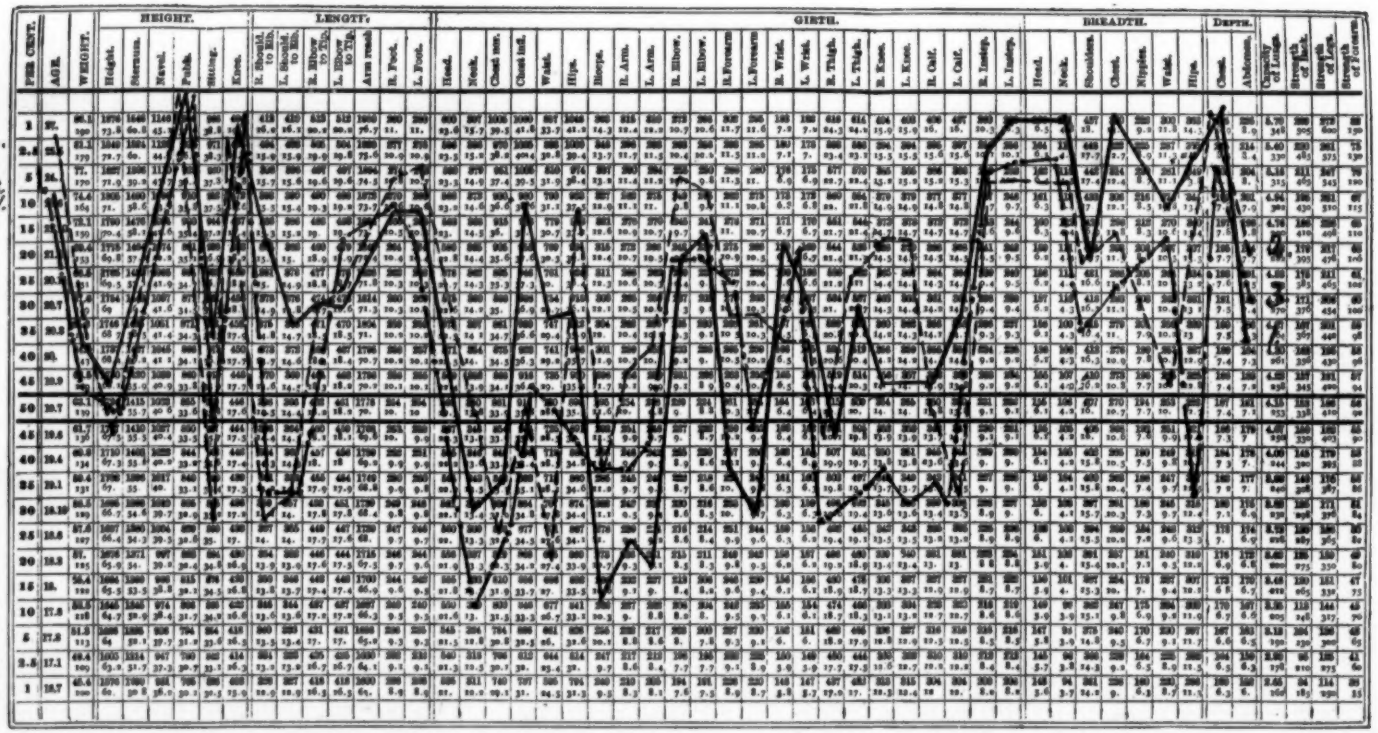

CHART A.—Anthropometric Table compiled from the measures of twenty-three hundred students. The large figures indicate millimetres and kilogrammes; the small, inches and pounds. Also the measures of (1) John S. Johnson ——, (2) Adolph Norsing — — — —, and (3) Olaf Nortwedt —— - —— - —— -, taken February 7, 1894, by R. Tait McKenzie, M. D.

drawing the thigh bone back and out. The hamstring muscles (H) have a similar action, with addition of flexing or bending the knee joint. As the stroke consists in a straightening of this joint, the skater uses the powerful extensors (E) to counteract this latter action of the hamstrings (H).

The extensor muscles (E) are tremendously powerful, and from their double origin on the pelvis and along the front of the thigh bone (femur) they are inserted into the knee-cap (patella), which changes the direction of their pull to a right angle by carrying them over the knee joint to their final insertion on the tibia, just as the wire of a door-bell is carried round the corners on its way to the kitchen. As the only function of the calf muscles (C) is to raise the heel and bend the knee, they will hardly be used at all in skating with long, flat racing skates.

In a speed skater we would look for a strong back and broad neck, due to his attitude while at work. His arms, which are kept idly folded on his back, would be small and weak, as would be his chest muscles. His abdominal muscles would get some work from the constant swaying, and he would have powerful, vigorous gluteal and extensor muscles, with sinewy hamstrings but undersized calves.

An examination of the measurements of some of our most noted skaters will show this special development even better than their photographs.

In the accompanying charts each measurement is compared with those of nearly three thousand Yale students, whose average, or more correctly whose "mean," measurements are inclosed in the two heavy lines, and may be said to fairly represent the proportions of the average young man. The variation from this average, or mean, is marked in percentages in the extreme left-hand column of the chart.

John S. Johnson, of Minneapolis, has had a somewhat meteoric athletic career. Although he has been wheeling and skating for nine years, he has been heard of only about three years, when his phenomenal time was at first scarcely credited. His decisive defeat of the hitherto invincible Joe Donahue in Montreal, February 3, 1894, in all distances up to five miles, brought him up to the top of the tree, where he has remained perched on its topmost branch till the present hour, unquestionably the best man up to five miles on ice. He holds nearly all the records in speed skating.

His trainer never allows him to tire himself, but starts him with short spurts and an easy pace; so that, although he had been eighteen months in training when I examined him (February 5, 1894), he had in that time gained twenty-six pounds. He was then twenty-two years of age, and weighed one hundred and forty-four pounds. While in his sitting height he is surpassed by forty-

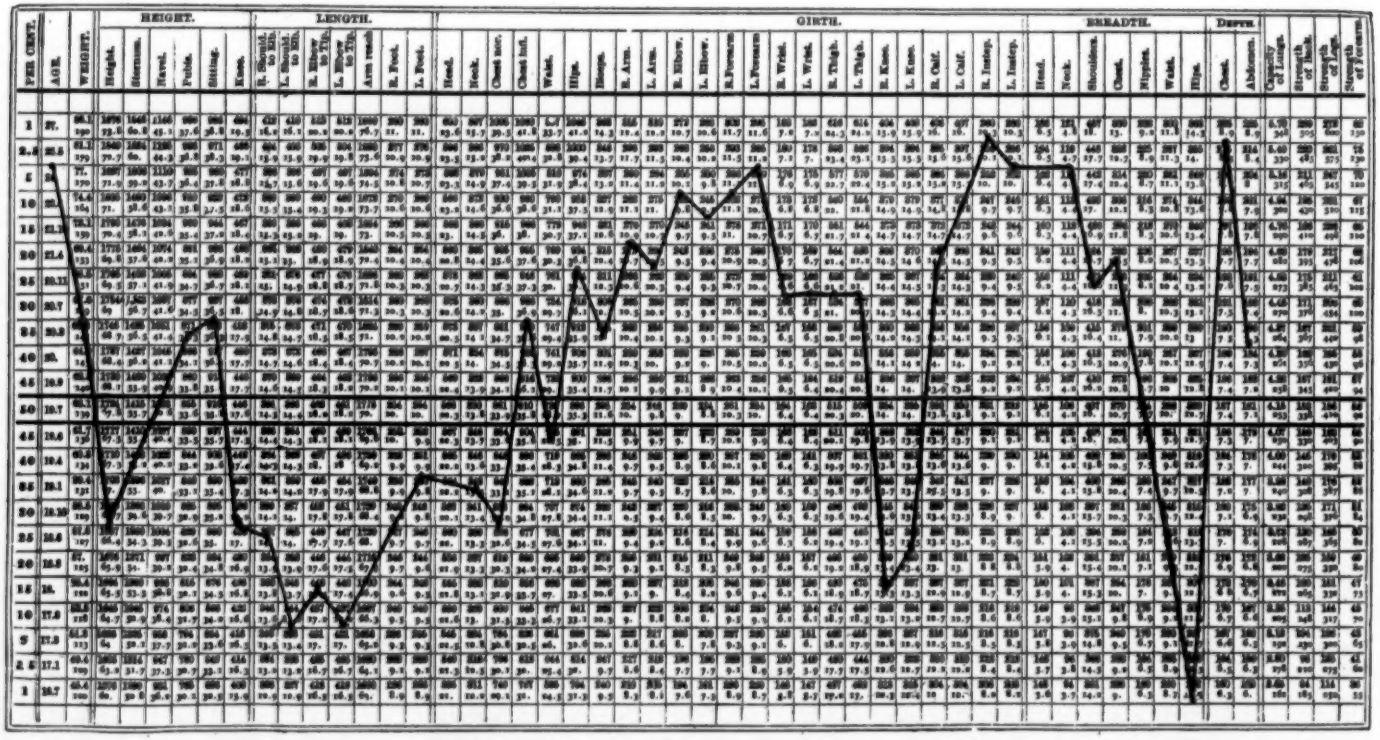

CHART B.—Anthropometric Table with the measures of J. K. McCulloch, taken in February, 1894, by R. Tait McKenzie, M. D.

five per cent of those measured (see Chart A, No. 1), his length of legs rises to the hundred-per-cent class. The girth of the neck is small, but the low chest measurement is due to its rounded shape.

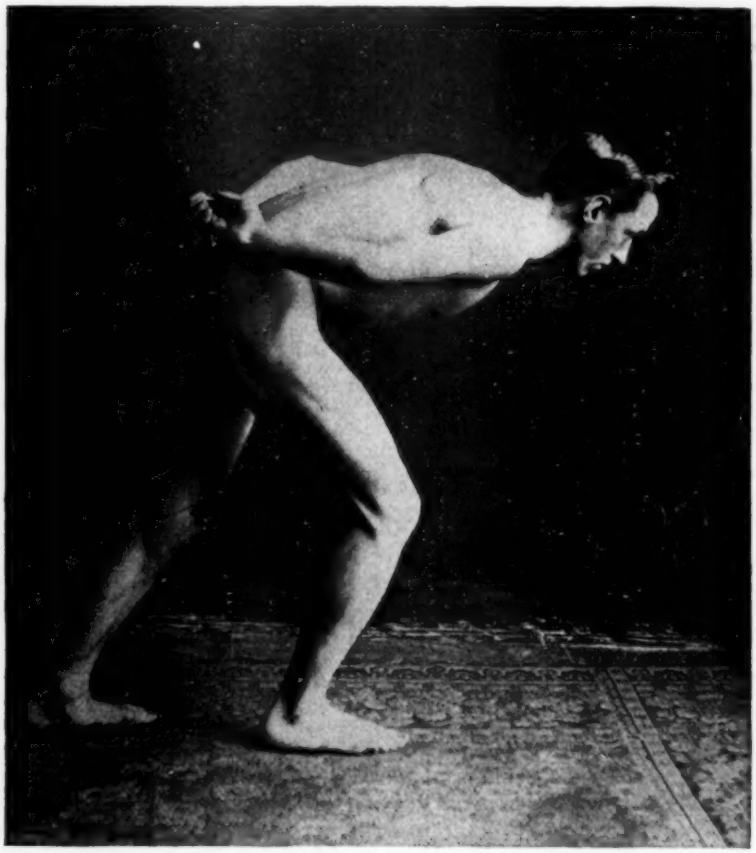

FIG. 4.—JOHNSON.

Its expansive power of seven inches is extraordinary in a chest of that shape. The muscle girths of his arms are exceeded by eighty per cent of young men, while the elbows and wrists show rather heavy bones. The rather small thigh girths will be due partly to their great length. The size of his calves shows about average development—to be attributed to bicycling largely—but the insteps are very large, and his photos show a flat foot. The neck and chest are broad, as would be the shoulders if he had better arm muscles. The "bicycle stoop," amounting almost to deformity in his case, brings the depth of chest up to the one-hundred-per-cent class. His lung capacity is very good, but he can not pull himself up by his arms more than two and a half times, and one dip on the parallels is the extent of his ability. His pulse is

only fifty-four to the minute—remarkably slow and strong, and not easily quickened by exercise. The long thighs and "bicycle stoop" are well shown in Fig. 4. Notice particularly the deep chest.

Adolph Norsing has skated since childhood on the rivers and fiords of Norway. For the last five years he has met the champions in this sport both at home and throughout Europe, and has visited America twice. He is a worthy representative of the land of the Vikings, and he now holds the Canadian record for half mile (1·24). His training methods are peculiar: two hours daily, finishing with about three miles at top speed, is his quota of work till the day of the race; his diet is principally oatmeal, eggs, and meat. He allows himself one glass of ale daily at dinner, but otherwise does not use alcohol and has never used tobacco. He is

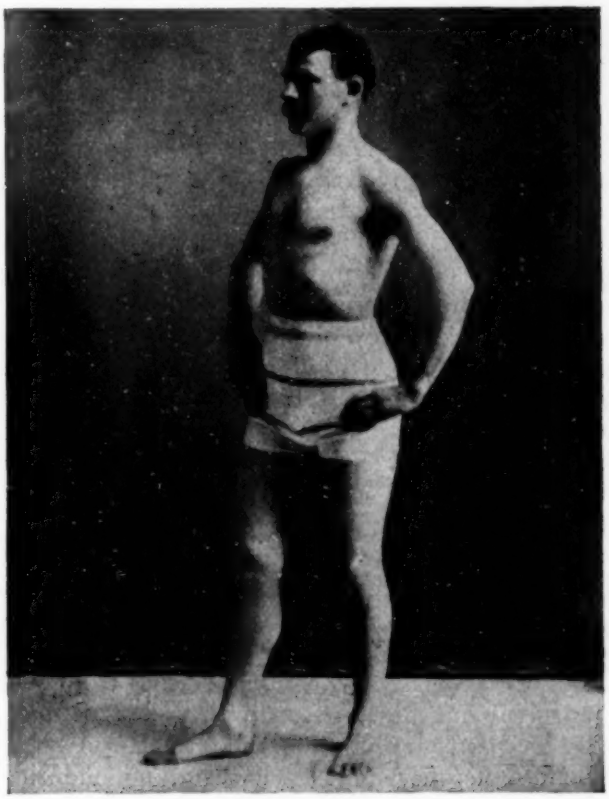

FIG. 5.—NORSING.

a typical skater; his occupation, that of a carriage painter, is sedentary, and we find in him typical development.

Although not above the forty-five-per-cent class in height, and with his sitting height surpassed by over seventy per cent of

young men, his length of lower limb is up to the one-hundred-per-cent class, as in the case of Johnson (see Chart A, No. 2). His other bone lengths are low, except his feet, which are long. The hip and elbow girths show heavy bones. An old fracture of the left femur, with shortening, invalidates the thigh measures somewhat, but the calves are away below the knee girths, while the insteps show a condition of flat foot in this man also.

Great breadth and depth show splendid lung power in a chest round, capacious, and barrel-shaped, but not very mobile, for he has small expansion. His pulse is rather fast (eighty-four), and his strength tests, much above his muscle measurements, would give the impression that if determination and will power can do it he will always be a winner.

In his case, as in that of all the men whose measurements are here shown, the left thigh is the larger, probably from having to bear the body weight in turning the corners of a rink. Fig. 5 shows well the rounded shape of the chest in expansion, also the type of figure shown in the chart.

J. K. McCulloch, of Winnipeg, is certainly the best representative that Canada has produced lately in speed skating, and he takes front rank both in this sport and in bicycling. We would hardly expect the typical development of a skater, however, in this man, who excels as a gymnast and all-round athlete as well. At eleven years of age he was winning boys' races, and his summer evenings are taken up by rowing, canoeing and lacrosse. For the last three years bicycling has been his main form of athletic exercise during the five summer months. In winter he is the mainstay of the Winnipeg Hockey Team, and his special *penchant* for the parallel bars in the gymnasium shows in the well-developed arms and chest. His measurements, plotted on Chart B, show a few of the characteristics of the skater. With height in the thirty-per-cent class we find comparatively short legs and long thighs. His arms are also short. A glance at Fig. 6 well shows the shortness of his leg. His muscle girths are in the eighty to ninety per cent class, while his knee-bone measurements are down to twenty per cent; his narrow hips give origin to very powerful muscles, whose girth make up for these bony deficiencies to speed skating (see Fig. 6). His calves are large, but he tells me since he stopped wheeling, four months ago, they have decreased nearly an inch and a half in girth.

His chest is deep and his strength tests show well-developed arms and back. Fig. 6 shows where his extraordinary speed is obtained: the driving power lies in the very long and muscular thighs. This young man is a natural athlete, and, although not built for a skater, excels in that sport as he would in almost any

he took up. He would make a splendid high or broad jumper, and would be a success as a gymnast.

Fig. 7 shows a typical speed skater—Olaf Nortwedt, a professional, aged twenty-four, who has been on skates almost since he could walk. He has taken no other form of exercise, and his best distances are under three miles. This photo, taken on the eve of a race, shows the fine condition of his skating muscles. Here again the body is short—the length of the leg and thigh in the one-

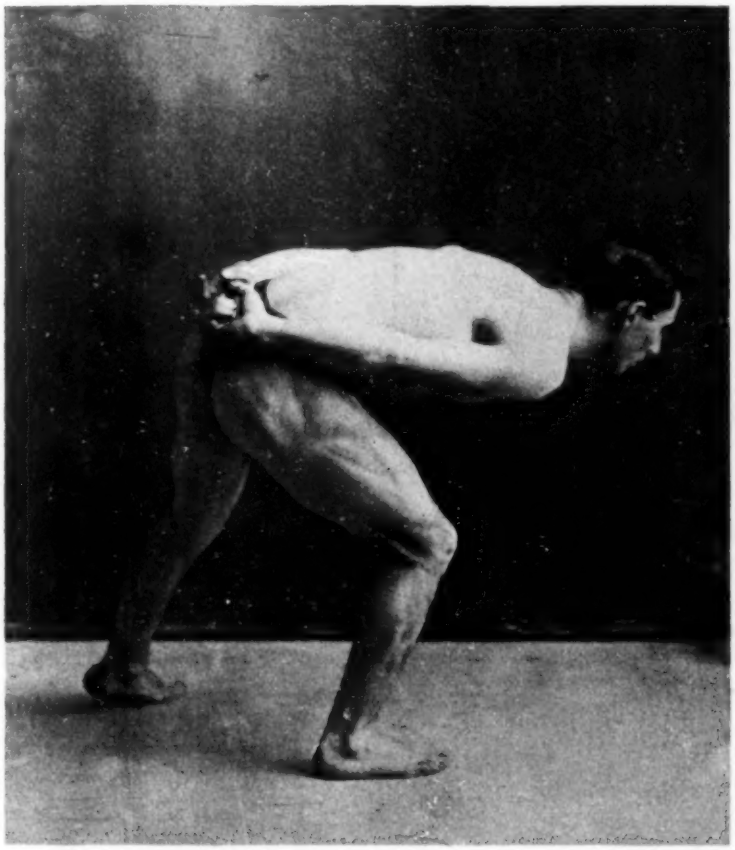

FIG. 6.—MCCULLOCH.

hundred-per-cent class (Chart A, 3), while the arms are not long in proportion. The feet are long and flat, and as a rule his other bone girths and lengths are large, with small muscle girths. The rather small thigh girths are due to their great length in conjunction with very narrow hips; his chest is deep and round, although not mobile. His strength tests show weak, poorly developed arms, but the breadth of neck in him, as in Johnson and Norsing shows good development in the upper muscles of the back. His

occupation, that of clerk, is light, so that the natural development of a skater has not been interfered with by other causes, as in the case of McCulloch. The plotting of the measurements of these three great skaters, Johnson, Norsing, and Nortwedt, on Chart A, shows the remarkable similarity of their build. All are about the same height and weight, and we find in all certain characteristics. The typical speed skater has a short body, capacious, round chest, with well-developed back; his thighs are strong and very

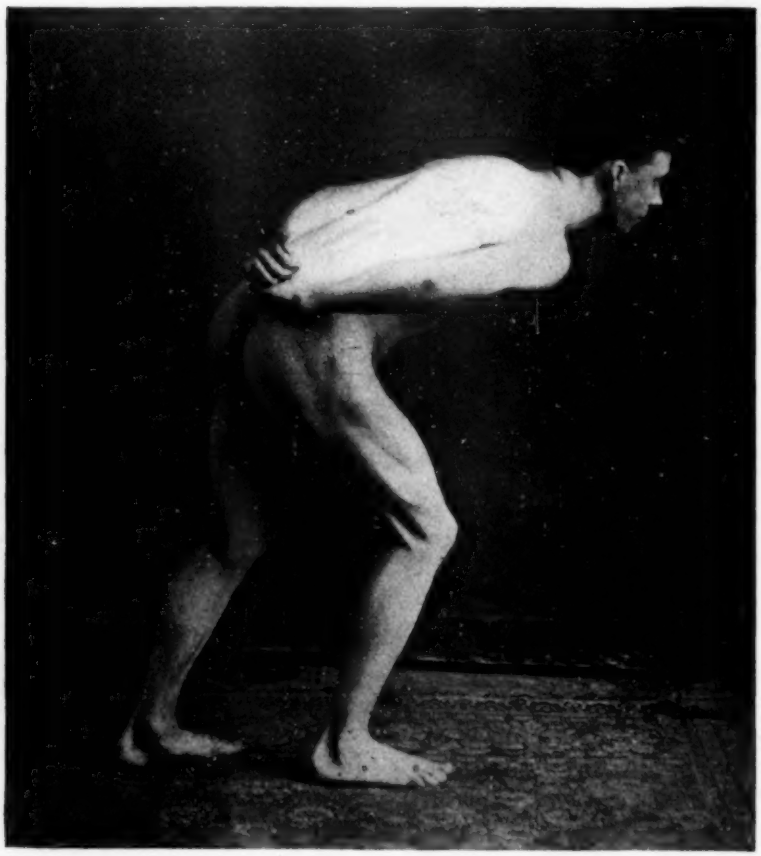

FIG. 7.—OLAF NORTWEDT.

long, as are also his legs. His feet are large and flat. His weak points are his calves, due to the long, flat skate to which his flattened foot is so closely bound. The large muscles of his chest are not exercised, and his arms, held lying idly along his back, are unused except in an occasional spurt, when they are brought down and swung straight from the shoulder. They say that they catch less wind held that way, and that the position is restful to the tense extensors of the back. This is, no doubt, true, but the result is

disastrous to symmetrical development. This type of figure is seen at its best in such skaters as the Donahues, McCormick, the old-time professional, who still skates a fast race although now forty years of age, and in Wilson Breen, a professional, who has been a winner of much gold and glory by means of his long legs and powerful thighs.

The conclusion that speed skating alone is not a good exercise to develop a well-built, symmetrical man will be patent to any one who reviews the facts. If indulged in, it should be, as done by McCulloch, in conjunction with other forms of athletics which bring into action the muscles of the arm, calf, shoulders, and chest.

SUGGESTIBILITY, AUTOMATISM, AND KINDRED PHENOMENA.*

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I. MENTAL CO-ORDINATION AND ORGANIZATION.

THE thoroughgoing parallelism of mind and brain may be regarded as an accepted principle of current psychology. There remain, it is true, a few psychologists who dispute it, and many of those who accept it as a working principle refuse to regard it as final. It is conceivable, say they, that when our knowledge is more complete we shall discover that the relation of mind and brain is very different from what we now suppose it to be. Yet we may be sure that the facts upon which the doctrine of parallelism rests will never be set aside by any new discoveries, and will find their place in that final theory toward which we are slowly moving.

It is somewhat surprising that few, even of those who accept this theory as a working hypothesis, have endeavored to carry it out into all its logical implications and to see how far they will fit the actual facts. It is my own belief that the more thoroughly this is done the more probable does it appear that every mental state has its accompanying physical process, and the more rigorously we apply the dynamic conceptions suggested by our scanty knowledge of these physical processes to their accompanying

*I wish to acknowledge my indebtedness to the recent French and English writers on these topics, especially to Pierre Janet, with whose theory as developed in his work, L'Automatisme Psychologique, the above doctrines are essentially identical. It should be noted, however, that Janet expressly repudiates any attempt to bring his psychological theory into connection with our psycho-physiological speculations.

mental states, the more intelligible does our inner life become to us. Especially is this true of certain curious phenomena to which our current psychology pays little attention—those of automatism, suggestibility, and double consciousness as seen in hypnosis, spirit-writing, trance speech, *et id genus omne*. Not that we are yet in position to explain these phenomena in detail. There is much that defies analysis at our present stage of knowledge, but I have no hesitation in saying that in these dynamic conceptions we have found the key which will in time solve these and many other psychological riddles.

We know little or nothing of what happens in the brain while we live and move and have our being. In the early days of experimental psychology the physical bases of mental states were crudely conceived as gross movements, either of the nerves themselves or of some fluid supposed to flow along the nerves and veins to the brain and heart. Nowadays these simpler conceptions are displaced by theories of chemical activities or molecular vibrations of some kind. For my own part, I am sometimes inclined to suspect that the true physical basis is none of these, but a disturbance of the same medium that transmits light and heat —the ether—and to regard the cellular and fibrous structures of the nervous system as a mechanism for producing and transmitting these disturbances, much as the battery and wires of an electric circuit produce and transmit that mode of ethereal disturbance which we call electricity. However this may be, it is quite certain that the processes which take place in the nervous system are all of one order and are analogous to—nay, a part of—the physical transformations of energy which we see in the outer world. Their proximate source is the stored-up molecular energy of the food we eat; they are disengaged by the operation of external and internal stimuli; they can re-enforce or destroy one another; they can produce extensive muscular, secretory, and nutritive changes in the body.

Although all of these processes are of essentially the same order in that all taken together form one system of forces, the constitution of every part of which depends for its character upon the constitution of all the coexisting parts, it is probable that consciousness is not connected with every part of the system, but only with those processes that take place in the cortex—that is, the outer layer of gray matter that covers the surface of the brain. At every moment of conscious life the cortex is the scene of activities so delicate and complex that we can never hope to frame an adequate conception of them. The masses of cells are forever disengaging pulse after pulse of molecular or ethereal disturbance, probably of a vibratory character; by the countless systems of interlacing fibers these pulses are transmitted from

one cortical area to another; meeting, they re-enforce or destroy one another; impinging upon a cell system which was in comparative quiet, they rouse it to activity, and are themselves modified by the pulses which it gives forth. At every second this mass of activities is receiving from the myriads of nerves that reach out to the eye, ear, skin, and other sensitive portions of the body countless other pulses of the same character, but initiated by the physical stimuli of the external world or by the chemical changes of the body. These pulses are not accompanied by consciousness, but when they reach the cortex they merge into the complex mass there existing and contribute their share toward the character of the total conscious state. And in the last place, the activities disengaged within the cortex are ever discharging downward through the outgoing channels into the co-ordinating mechanism at the base of the brain. This controls the systems of muscular contractions needed for the performance of our bodily movements much as the "combination stops" of an organ control the systems of pipes needed to produce any given timbre effect.

Thus the consciousness that you and I at any moment experience depends for its character upon the constitution of a system of activities as definite and determinate as any known to the physicist, although so complex that we can never hope to unravel it. To compare the complex with the simple, we have all seen the play of color upon the surface of a soap bubble. These colors depend for their character upon the constitution of a system of forces far more simple than that which underlies the human consciousness. They are due to the interference of waves of ether reflected from the inner and outer surfaces of the film; they depend, therefore, upon the angle of incidence and the thickness of the film. These two conditions again depend upon the tenacity of the film, the difference between the pressure within and that without the bubble, the action of air currents, the muscular tremor of the hand that holds the pipe, the action of gravity, etc. If any one of these conditions be in any way altered, some change will be made in the tint. This throws light upon one of the reasons why psychology lags so far behind the other sciences. Suppose the physicist should select that one square inch on the surface of the bubble where the colors were brightest, and should endeavor to formulate for each, in terms of the others, the laws of existence and sequence, ignoring the while the system of forces upon which those colors depend: however painstaking his efforts, they would meet with little success, and this has been the fate of the psychologist. Too often he has confined his attention to that portion of consciousness which was brightest, or for some other reason the most interesting, while if he had but looked into the marginal or

subconscious he would have found traces there of the activities which were all the while affecting the area of greatest vividness.

Not only is consciousness as a whole thus correlated to a system of physical forces, but we find that its several elements are also related to certain subordinate systems of forces which, while forming part of that total, have a certain degree of independence. It is known, for example, that the activities which take place in the occipital or hinder portion of the cortex are accompanied by sensations and ideas of color; those that take place in the temporal region, in the neighborhood of the ear, have to do with sensations and ideas of sound; those of the Rolandic region, which forms an archlike band passing over the brain from a point a little in front of the ear, are probably the basis of sensations and ideas of movements as felt. Since the awakening of these latter tends to produce or sustain the movement in question, and since volition is but another name for the initiation of a movement through an idea representing it or something with which it is associated, this is also a region essential to the performance of voluntary movements. And it is probable that all the definite qualities of sensation and the corresponding ideas are related to more or less well defined portions of the cortex. But we know that even our very simple ideas—as those of a rose, or a book, or a man—involve elements drawn from many of these sources. We must then suppose that the idea of a rose depends upon a co-ordination of processes which, although situated in different portions of the brain, act together in the production of this idea. As my thought flits from the color to the fragrance, to the touch, to the plucking of the rose, so do the pulses of energy pass along the conducting fibers from the region of vision to that of smell, to that of touch, to that of movement. Further, as the rose is to me a relatively stable thing, we must suppose that these physical processes are not merely co-ordinated for the time being, but are organized into a quite permanent system which retains its coherence and existence as a system as long as the idea of a rose remains to me one and the same idea, although consisting of unlike mental elements.

I can not undertake to work out in detail many of the more complex organizations or systems which we can detect in mind. To do that would be to write a treatise on psychology, and my only object at present is to make clear the conceptions of co-ordination and organization. Yet to two of these more complex forms—and they are unfortunately the most complex of all—I must make some reference, since a comprehension of them is presupposed in the application of this theory to the curious phenomena which we wish to explain.

I have shown that the state of consciousness at any given mo-

ment involves a very complex co-ordination of the forces that underlie it. And I have also shown that the permanent existence of any element of consciousness, if at all complex, involves not merely a co-ordination, which might be temporary, but a permanent organization of certain of those forces into enduring systems. Not enduring in the sense that they are always actively operating, but in the sense that when any one element is active it calls into activity the other elements as well. The same is true of consciousness as a whole. We may discern this in two quite different forms. The first is what we may call the permanent form of consciousness. We observe that at any given time consciousness has a certain form of organization which is so constant that we are tempted to think it can not exist in any other form. Some one element or organized group of elements tends to be more clear and distinct than the others. This one is called the center of attention or focus of consciousness; the others constitute the margin. From moment to moment the focus shifts; new elements rise into dominance, and the old fade away. Yet there is always a dominant element, and this it is to which we attend. Usually the focus and margin are inversely related to one another; that is to say, when any given group tends to become more clear and distinct the other elements tend to lose with respect to clearness and distinctness. This is what we mean when we say that we can not attend to two things at once. But it is not always true. There are states in which the heightening of one element tends to heighten all the others as well. In imminent danger, for instance, there is frequently an intense exaltation of the total content of consciousness, and the same phenomenon is occasionally found as a precursor of an epileptic attack. Now, this constant form into which consciousness tends to fall, and which is, by the way, the basis of our notion that the mind is a single entity of some sort, is very suggestive. We know that all physical forces, if they can in any way act upon one another, tend to coalesce into one common resultant, and I think it probable that in the law of attention we see the mental manifestation of some form of coalescence between the physical forces which form its basis.

Again, the consciousness of each of us forms a permanent entity which we severally call "myself." Into all the problems connected with this word of many meanings I can not enter, but of one thing we may be quite certain—whatever the consciousness of self may be, it is largely dependent upon the continuity and uniformity of our memories. Any great change in a man's life which introduces into his present a mass of experiences quite out of keeping with his past is apt to introduce into his consciousness of personal identity a strange sense of unreality and uncertainty. He rubs his eyes and says: "Who am I? Am I really John

Smith? Am I the man who did this and that? or is it merely a dream?" And when we go further, and totally destroy a man's memories, as not infrequently happens in cases of disease or accident, we find that the consciousness of personal identity is also gone. The man may know that he is *somebody*, or at least that he *ought* to be somebody, but he can not tell who he is. If the injury be greater still, even this consciousness that he ought to be somebody is lost, and the patient sinks into a condition of dementia, which we can not well understand because it is so utterly unlike anything that we have experienced.

Now, evidently, this is very like the case of the simple idea. I have shown that the permanence and identity of any such idea, as that of a rose, which is the standard illustration in psycholgy, depends upon the organization of a permanent system of physical forces of some kind, and I think we have reason to believe that the man remains the same for much the same reason, although the elements entering into that system are a thousandfold more numerous and more complexly interlaced.

PROFESSOR FORBES ON "HARNESSING NIAGARA."

By ERNEST A. LE SUEUR, Sc. B.

THE past few months have seen the successful completion of a gigantic work, of epoch-making extent and significance—the Niagara Falls electrical power transmission plant. An article appeared in these pages in September, 1894, describing something of the difficulties which had been met and overcome by the engineers in charge of the water power and generator installation of the Cataract Construction Company, as the corporation which had the contracts for erecting the plant was named.

Prof. George Forbes, who held the position of consulting electrical engineer to that company, is to be heartily congratulated upon the success that has crowned his efforts. It becomes pertinent at present to insist, however, that Prof. Forbes should be content to limit his claims to glory to the considerable work that he has undoubtedly accomplished, for, unfortunately, he appears not overanxious to define that limit when discoursing to the public about his achievements.

There has been some bickering between Prof. Forbes and Prof. Rowland, of Johns Hopkins, as to which of the two was the originator of certain of the novel points in the Niagara Falls Power Company's generators. The atmosphere is very murky in consequence, but some facts would seem to have filtered through, and we shall take occasion to refer to them later. What seems

to call for notice at this moment is a paper by Prof. Forbes, which appeared in the September Blackwood's, entitled Harnessing Niagara.

It is doubtful if any American magazine would have published that article, even had it contained fewer references to the shortcomings of the United States. It seems to us, however, that it would have been much better for it to have appeared in this country than in Great Britain, because of the freer criticism it would here have had, and because America's faults would then have been told where it might be hoped that, coming from so authoritative a source, certain valuable reforms would result.

A large portion of the article is devoted to a description of Forbes's own unusual endowments and capabilities, natural and acquired, which, it would appear, fitted him for the position of consulting electrical engineer to the Cataract Construction Company, not less than for the suppression of the American railway conductor.* A perusal of the article brings to one's mind the couplet by a famous English librettist:

> "He was the bravest man in France;
> He said so, and he ought to know."

Having noted the title of the paper, we are astonished at the space that is devoted to placing the demerits of this country in relief against the author's excellences, especially in so short an article. To quote certain instances, he says: "There are two great mistakes commonly made as to Americans: one is, that they are original inventors; the other is, that they are humorous. Neither of these propositions is true." The chief argument he advances against our possession of humor is that "their periodical literature is filled with so-called wit, but it smells strongly of the midnight oil." This is most sadly true, but, if one on this side of the water may judge, how much more so is it with British publications of alleged humorousness! The professor admits, however, that in the matter of humor there are some most brilliant exceptions in America. May we not ask whether Great Britain, for instance, can produce exceptions in this line to vie with the United States?

In support of his theory that the inventive faculty is lacking in the New World, he states that Americans are competent merely to design, not invent, and, by implication, informs us that his own talents in the inventive line are the real article, and that

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* He informs us that on a New York Central train he created disorder in the ranks of six (?) conductors ("the most insolent class of men in the country"), who filled the smoking room to the exclusion of himself. The subsequent verdict of one of the conductors is stated to have been that there were no flies (*sic*) on Prof. Forbes.

no American was competent to undertake what he has successfully accomplished; and, later, dwells at length upon his improvements in dynamo construction in the matter of revolving fields. The importance of the device of rotating the fields instead of the armature in the situation he was dealing with was great, but, as that was the form of the first alternating dynamo ever constructed (in 1833), the novelty of the mere principle, which is what he refers to, is not greatly in evidence, nor, we may add, is the inventive faculty.

In leaving the non-inventive-humorous proposition he says: "Invention and humor require a gift of imagination, the same gift that shows itself in poetry and letters, in music, painting, and sculpture; and in no one of these directions has this gift of imagination been found to predominate among Americans." Letting the last sentence pass, we may observe that it would be as pertinent to deny to the ancient Greeks the possession of any one of the qualities last named because (what will probably be admitted) the inventive talent did not predominate among them.

"They like giving big names to things in America," says our scientist. "A pond is a lake, and a hill is a mountain; they never speak of the sea, it must be called the ocean; a meeting is a convention, a dictionary is a 'speller and a definer,' a town is a city, a chairman is a president, and so on." If I am not mistaken, Max O'Rell has told us much the same thing, and we ought therefore to take it to heart. O'Rell has wonderful insight and an unfailing impartiality, which Prof. Forbes lacks. Take, for instance, the cases the latter cites in support of his proposition. How false some of them are, and how purely local most of the rest! Then, to take one of his instances, it would seem as though Americans were not exceeding their rights in using the word "city" in the nationally defined technical sense of a place of over such and such a population. The method possesses indisputable advantages over the British plan, by which, we understand, no place without a cathedral can be called a city. The latter system of nomenclature has much to recommend it on the ground of mediæval simplicity, but results in the omission of several places of great size and importance from the list of English cities.

We are informed that in this country "the average man is not a good specimen. He is apt to be a most awful 'bounder,' has no taste, and does not know the meaning of the word 'repose.'" We must waive comment on the first accusation on the ground of insufficient information as to what a bounder is. As to the rest, we might suggest to Prof. Forbes that one may possess all the repose that ever marked the caste of Vere de Vere, when experimenting with *bons mots* on railway conductors, and yet be sadly wanting, both in that quality and in the good taste he refers to, in his liter-

ary efforts. One singular example of lack of dignity in the paper under discussion is an attack on Lord Kelvin, describing a line of action of his as hitherto unknown among professional men, in which he attempts to take the edge off that statement by mentioning that distinguished man as his most esteemed and oldest scientific friend.

A remarkable thing is that Prof. Forbes admits that there are exceptions to his somewhat sweeping condemnation of this country, for, after making the uncompromising generalization about the average American, he says that it is not necessary to meet the specimen except in hotels and trains, and thereafter follows a list of no less than fifteen names in one paragraph of fashionable friends of his who were, of course, delightful, the bearing of which on the title matter of the paper is obscure. At the beginning of his article also he makes disparaging reference to our experts, and, at the end, "wishes to bear tribute to the kindly friendship which I almost universally experienced at the hands of American engineers." We have one fine sentiment to record: "An Englishman in America should always try to retain his Englishness." This should apply to any one who is proud of his country; but, unfortunately, the reasons the professor urges for holding that aim in view constitute only another fling at Americans.

Turning now to such portions of the paper as do actually bear upon the Niagara work, we have, as above mentioned, the professor's remarkable claim to originality in the matter of the revolving fields. Again, in describing the steps leading to his choice of apparatus, he says: "I soon realized the fact that not only could the latter (alternating) current be more easily obtained at high pressures, but that it could more easily, and without moving machinery, be transformed to any required pressure at any spot when it was wanted." This statement, it is to be regretted, is nothing short of dishonest. Forbes is here speaking of the year 1890, at which date the fact that he refers to as having worked out for himself was literally the A B C of electrical work, and part of the common knowledge of thousands of "line" laborers throughout the world.

With regard to the two points so far mentioned the distinguished engineer has not sought to belittle the work of others, but only to magnify his own; he has not, however, confined himself to this more moderate course, and we find him stating that "the highest scientific authority in America had taken up the same position as Lord Kelvin," referring to the latter's alleged strenuous opposition to the use of the alternating current. The eminent authority referred to would seem to be Prof. Rowland, of Baltimore. This gentleman, who ought to know what it was he

advised, states positively that he did not strenuously oppose the use of the alternating current; that he did not oppose it at all; and that, moreover, his opinion was given in 1889, not 1890; that what he did advise at that early date, in view of the untried state of either direct or alternating current transmission, was merely caution in adopting plans, which advice, we may add, was most carefully followed, as will be seen from the fact that the main plans, not to speak of the details, were not decided upon until three years later, during which interval some most remarkable developments had taken place both in the design of machinery for use with alternating current and in the practical transmission of the latter over an immense distance in Europe.

Our writer says: "Until I went to America the manufacturers of electrical machinery never had a consulting engineer to reckon with, but dealt directly with the financiers, who knew nothing about cost or efficiency of machinery," and reference is later made to his being the first to get guarantees of performance from manufacturers of such machinery. The present writer speaks from personal experience in declaring this to be incorrect. The way in which a company, larger and even more representative than the chief one with which Prof. Forbes did business, filled an eleven-hundred-horse-power contract under guarantee, and later supplied an auxiliary generator to make the guarantee good, would perhaps have impressed that gentleman. The particular occurrence referred to is immediately within the writer's knowledge, and the extremely exacting specifications for the said machinery were written and insisted upon by consulting engineers and not by the financiers. It should, however, be unnecessary to say that, of course, the method of requiring guarantees and of employing engineers to write specifications was common in the electrical business, as well as in all others, long before the advent of Forbes.

There are other points in the professor's paper besides those already referred to which require contradiction, and still others, covered by the matter in controversy between himself and Prof. Rowland, which there is every reason to believe might be improved in the matter of accuracy, but which, since directly opposite statements are put forth by the two men, we must be content to let stand in default of other sources of information regarding them.

An opinion of Prof. Forbes that surprises us is set forth in the sentence, "I had always wished to put the dynamos at the bottom of the pit close to the turbines, and I still believe that this arrangement would have served us better." It is the opinion of the writer that it is an unusually good thing for the Niagara Falls Power Company that the above was not done. In his ex-

perience it is a practical impossibility to keep penstocks under great head from leaking, and the moisture thereby communicated to the atmosphere, as well as that due to the location of the dynamo room at the bottom of a narrow pit one hundred and fifty feet deep, with a torrent carrying a hundred million gallons per hour raging immediately beneath, could not well fail to impair the machines' insulation. Since the latter must carry a vast electrical pressure of alternating current, any impairment would be fatal to the maintenance of the plant. An instance occurs to mind in which a generator plant was located on a level with the wheel cases, and this not at the bottom of the pit by any means, but at the top of a draught tube some feet above the level of the surrounding ground, and in which, owing to the moisture unavoidably present, the generators had subsequently to be removed.

It is impossible, without quoting most of the article in question, to convey an adequate impression of the egotism that pervades it. A few phrases may, however, be of assistance to an understanding of this.

"The electrical work which I have carried out has been done at a cost that seems incredible to many."

"I did not care to go much into society."

"On such occasions I would write to my millionaires and tell them that if they did not do what I told them," etc.

"I had a lovely house in parklike grounds."

"I had a nigger servant."

"I had thus become well acquainted with the system which Nicola Tesla, a young Montenegrin, was experimenting on," etc.

We fancy that most people know the name and fame of "the young Montenegrin" a good deal better than they do those of Forbes.

In fact, the whole article is quite alliterative from the continuous repetitions of the first personal pronoun singular.

In an opening paragraph Prof. Forbes speaks of the production of the paper under discussion as the result of an attempt to curb a natural tendency to reticence, and, later, in describing the Falls of Niagara, he says, "The most impressive points of view are those that make you feel the smallest." It is not apparent whether the professor himself experienced the sensation, but, if he did, the depression must have been evanescent, for near the end he says that, while his company ascribes his "splendid results" mainly to engineering skill, "I am inclined to believe that they were fully as much the result of an exercise of tact, judgment, and forbearance, combined with firmness—qualities which I do not hesitate to say that both the officers of the company and myself recognized in each other." All of which, while possibly true, is scarcely the utterance of a man hampered by a temperament in

which reticence and a feeling of insignificance are struggling with each other for supremacy.

Americans have faults and are not more sensitive to having them pointed out than other people, but the tendency among descendants of Anglo-Saxon stock to resent the imputation of the possession of visual motes by ill-tempered owners of larger ocular imperfections is deeply rooted. We have not for many a long day seen an article in a prominent English journal so well designed, by its gratuitous disparagements of America, to keep alive the fast-expiring dislike to the mother country that it is to the interest of all of us to see buried.

HEALTH EXPERIMENTS IN THE FRENCH ARMY.

By STODDARD DEWEY.

THE report made to the French Parliament in April of this year by General Zurlinden, Minister of War, discloses a new aspect of that life in barracks to which the armed peace of Europe condemns all her young men for a period of their best years. It is nothing less than an experimenting on a giant scale with the health and resistance to epidemic disease of French youth under military regimen.

The first and most fatal enemy has always been typhoid fever. In 1887 the annual number of cases reached eight thousand, with a death-rate of about eight hundred, for much less than five hundred thousand men. This gave an average of deaths from this single disease very nearly equivalent to two out of every thousand men, while the total mortality of the army was only 8·43 per thousand. In the mortality of French civil life, which remains at eleven per thousand, the destructiveness of typhoid fever is still greater, at least in a large number of towns and cities.

Doctors have long known the cause of the prevalence of this disease; but it is not easy to persuade the ordinary citizen of the necessity of precaution in the use of so common a thing as water. Jules Simon tells a story, good by way of illustration, of the alarming typhoid epidemic in Paris a few years ago. Both doctors and Government had warned the people that the germs of the disease were contained in the water of the Seine, and that only filtered and boiled water could be used safely. One day a *café* waiter was discovered replenishing the drinking decanter of his customers from the common spigot giving forth the river water in its unadulterated impurity. When reproached with his deed, he answered indignantly:

"My father and my grandfather drank this water, and they lived to be old men. I have no time to bother with doctors' notions."

During the last month of March there was a sudden outburst of a strange and fatal disease among the old men in the city poor-house at Nanterre. It was accompanied by tetanoid symptoms (lockjaw), and was attributed by the physician in charge to the ergot of which he discovered traces in the very bad rye bread furnished to the inmates. The director, when asked about the reason assigned, is reported to have answered comfortably, "Doctors' humbug!"

It is the good luck of the army that an intelligent service of hygiene can be enforced whenever the authorities wish. The will began with M. de Freycinet, who was Minister of War through so many changing administrations. He set about substituting spring water or filtered water in place of the water from wells or rivers, which had previously been used by garrisons. By 1890, in comparison with 1887, the number of typhoid cases had diminished in the proportion of thirty-six per cent. By 1891 the decrease was forty-nine per cent. In the single military jurisdiction of Paris it reached seventy-five per cent. This astonishing and satisfactory change followed immediately upon the change of the water supply.

The record of the last three years only confirms this brilliant demonstration of the real work which can be accomplished by rational hygiene. There were five hundred and forty fewer cases of typhoid fever in the army posts in 1894 than in 1891, though the percentage of deaths to cases was slightly higher. But the most striking facts are found in the statistics of particular places like Paris, which has always had the reputation of being a center of this special disease.

Among the soldiers under the military government of the city there were eight hundred and twenty-four typhoid cases in 1888. The following year the number increased to eleven hundred and seventy-nine. At that time the water of the Vanne was substituted for the contaminated Seine water. The cases of the next four years numbered, respectively, only two hundred and ninety-nine, two hundred and seventy-six, two hundred and ninety-three, and two hundred and fifty-eight. Last year the Vanne itself became contaminated through an accident, the history of which has been traced conclusively. The result was an increase of typhoid cases in the Paris garrison to four hundred and thirty-six, of which three hundred and ten occurred in the three months of February, March, and April. During January and February of the present year (1895) there were only eight cases in all.

The fact that typhoid fever comes and goes with impure drink-

ing water could hardly receive a more striking demonstration. Yet the possibility has been realized in the experience of Melun, a garrison town of about twelve thousand inhabitants, situated on the Seine, twenty-eight miles above Paris. Here, in 1889, there were one hundred and twenty-two cases of typhoid fever among the soldiers. The Chamberland filters (Pasteur system) were then introduced, and the cases of the following years numbered, respectively, fifteen, six, two, seven, and seven again for 1894. Suddenly, during the severe weather of February of this year, twenty-eight dragoons, one after the other, came down with the fever. The infantry battalion, living in the same barracks, had not a single case. The secret was soon out. The filters had been allowed to freeze and the soldiers were ordered to drink only the weak infusion of tea furnished them, in which, of course, the water was boiled. The dragoons had simply not obeyed, but had helped themselves to the Seine water from the hydrants.

At Lorient, as in other districts of the coast of Brittany, typhoid fever has long been endemic and still remains so among the civil population. In the garrison, until 1889, there was an average number of one hundred and seventy cases yearly. In 1890 filters were set up, with the result of a decrease in the cases to fifty-eight for that year, while the three following years numbered only two, one, and one, respectively. In 1894 water was brought into the barracks from a spring supposed to be pure. In a short time eleven cases of typhoid fever declared themselves. On examination it was discovered that the spring was contaminated, and the garrison ceased using it for a water supply. The disease has now all but disappeared again.

Similar facts in connection with typhoid fever have been verified in more than twenty widely separated garrison towns. Of the cases which still appear where filtered water is used, the cause has invariably been found, when investigation was possible, to be some accidental use of contaminated water. Thus at Nantes, in Brittany, endemic typhoid fever was reduced by the use of filters to isolated cases. In 1893 there were seventeen, and in 1894 there were thirty cases needing explanation. It was soon remarked that nearly all were among orderlies, who have the habit of taking their meals in certain restaurants of the town. In each of these places it was discovered that the water used was polluted by infiltrations from privies. In four other garrison towns the same fact was reported.

A final instance, which is also one of the most remarkable, is that of Auxerre. Here one hundred and twenty-nine soldiers were down with typhoid fever in 1892. Filters were set up, and there was one single case in each of the two following years.

Only one objection has been urged against this triumph of the

theory that pure water is a preservative against typhoid fever. It is probably more apparent than real. It concerns the attendants on the sick in the military hospitals. These men can hardly be exposed to the danger of drinking contaminated water, and yet many of their number fall victims to each typhoid epidemic. In their case the disease seems to have a real contagion. But it should be remembered that the permanence of their service with the sick undermines their strength until the system no longer resists the action of the morbid germs, to which, moreover, they are exposed in a thousand ways. Their case is no exception to the rule that, under ordinary conditions of life, typhoid fever is propagated only by impure drinking water.

With dysentery—that other enemy of the soldier, both in garrison and during campaign—French military hygiene has not proved itself so successful. Until 1892 there was even a steady increase of cases, though not of deaths. Since that time there has been a diminution of cases and, in a measure, of deaths. So far, the only amelioration seems to result from a constant supervision of the daily disinfecting of privies, and from a provision of conveniences which spare the soldier the necessity of suddenly exposing himself to the chill of night in crossing an open yard.

With cholera, on the other hand, the most encouraging progress has been made. The epidemic of 1893 cruelly tried the civil population of Lorient. The garrison had but a single case. This was a soldier who contracted the disease in Vannes, where he had been in attendance on his mother, who died of it. The same experience was repeated at Brest, where the civil population suffered for months together. In the garrison only two cases declared themselves from first to last. In Marseilles, out of nineteen cases there were only three deaths.

For measles and scarlatina the French army has found neither remedy nor preventive. These diseases come to the barracks from the civil population, among which they exist permanently. Both have gone on increasing in the garrisons since 1887—measles with spasmodic intermittences, scarlatina steadily.

The most disquieting progress has been made by that strange malady—*la grippe*. This alone, from the first months of the present year, will give a high rate of mortality to 1895 among the military as well as the civil population. Only one conclusion can so far be drawn from the experience of the army. This is the simple fact that the disease is a permanent danger which military physicians have henceforth to foresee as they do cholera, cerebro-spinal meningitis, and diphtheria.

The latter disease, formerly so rare among adults, has also made alarming progress since 1888 among soldiers. It is now hoped that the antitoxine (serum) of Dr. Roux will be as success-

ful in dealing with the dangerous microbe in garrisons as it has been in children's hospitals.

Vaccination continues to give satisfactory results against smallpox. Certain attendant dangers, which are often alleged against it, are avoided by the establishment of what are called *centres vaccinogènes*, where military physicians supervise the preparation of suitable vaccine. This, in the form of a glycerinated pulp, has been distributed to the Madagascar expedition in quantities sufficient for the revaccination of all the men during the voyage out, and of all the porters and coolies that may be needed after the arrival on the island.

In typhus, the lesson of the barracks confirms what has long been thought to be the only safeguard against its spread. This is the total isolation of cases. The disease, which is so peculiarly contagious, seemed to have abandoned France (excepting certain remote parts of Brittany) after the wars of the first Napoleon. Two years ago it broke out among tramps in the workhouse of Amiens, and soon appeared in Paris. It afterward spread among the same class of the population, in and out of prison, through different parts of the country. In the following year, 1894, it broke out again, to the despair of the medical profession. It seemed to have come back to stay, though the present prospect is more favorable. During both these years there were only six cases in the army. Of these, two occurred among military infirmarians who had volunteered their services for the civil hospitals, and one was that of a gendarme whose duties brought him in close contact with tramps already attacked by the disease.

Certain lessons of hygiene, which have been learned from harsh experience by the army, are not yet appreciated by the general public. One of these is the necessity of keeping in hospitals those who are undoubtedly convalescent from epidemic or contagious diseases. This is sorely against the will of families, and often of the patients themselves, who demand permission to complete the cure at home. Formerly, when this was granted, a frequent consequence was a relapse, and, oftener still, a communication of the disease to a new circle of the population. This has been especially observed of typhoid and eruptive fevers, dysentery, and the *grippe*.

The French army also profits by all the recent discoveries in destroying the germs of disease. Disinfecting apparatus has been indulged in to such an extent that the health service is ready even for an unusual epidemic. What the French oddly call "*coaltarisation*" is applied constantly to the woodwork of barracks. Methods of permanent ventilation have also been adopted. Each garrison is now being provided with a suitable hospital, and the separate barracks have infirmaries well fitted up.

The final result of all this solicitude for the health of the soldiers, who are the choice youth of the entire nation, is twofold:

First, the steady lowering of the mortality among them is of itself an increase of strength to the army and the country. Thus, during the last five years, on the score of typhoid fever alone, hygiene has saved to France the lives of twelve hundred and sixty-five soldiers. In the seven years from 1880 to 1886 the annual death-rate was 8·43 per thousand. In the seven following years it sank to 6·63, and in 1894 to 6·20 per thousand. Meanwhile, the mortality among people who have not the advantage of living under enforced hygiene remains at eleven per thousand.

Secondly, the compulsory military service, with all its disadvantages, gives the younger generation a strong training in practical hygiene. All able-bodied Frenchmen now learn, during a term of years, the practice of bodily cleanliness and what constitutes the health of habitation. These acquired habits they bring back to civil life.

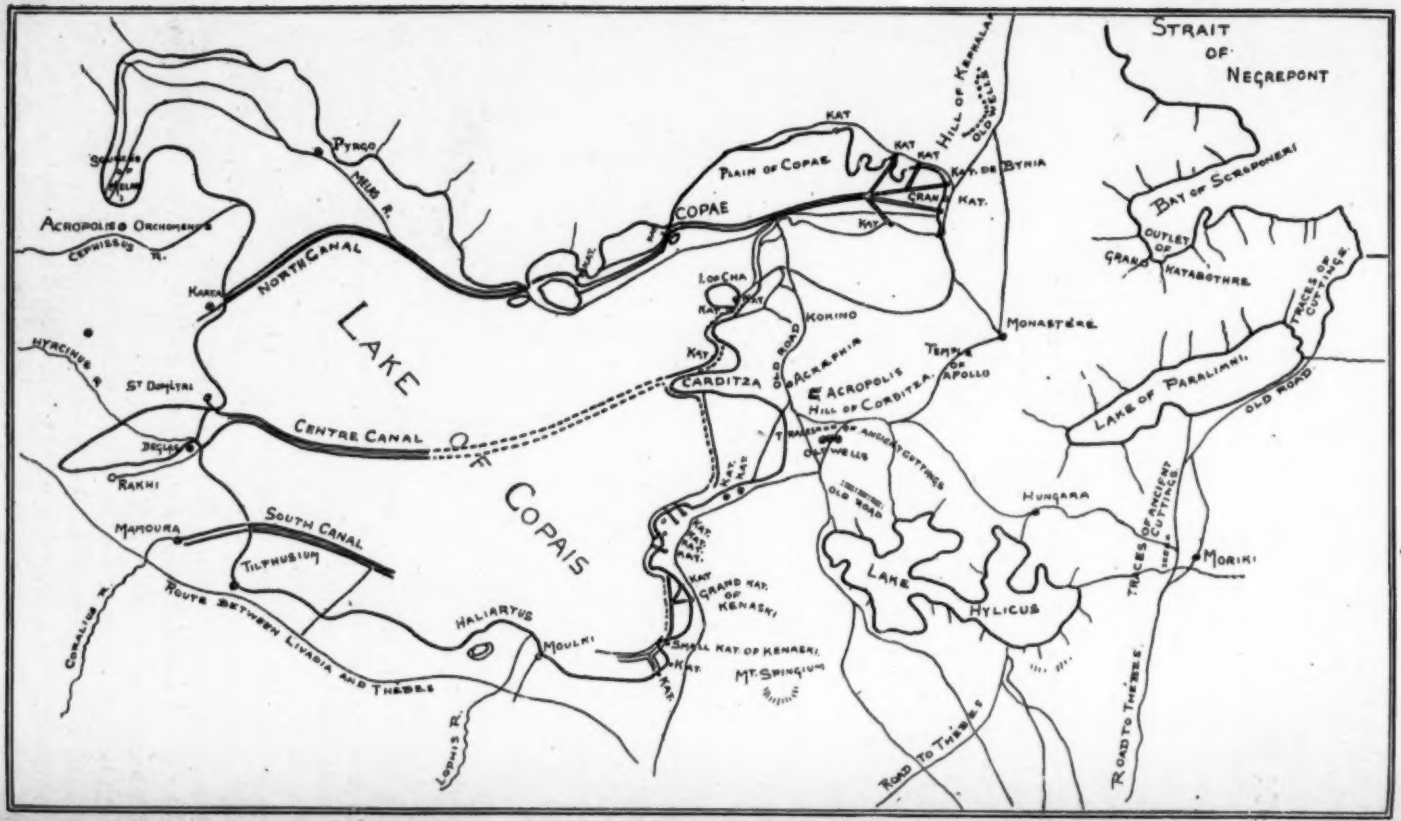
PREHISTORIC ENGINEERING AT LAKE COPAIS.

By JOHN DENISON CHAMPLIN.

HOMER, in his famous catalogue of the Greek and Trojan forces in the second book of the Iliad, enumerates more than twenty towns around Lake Copais which contributed collectively to the Greek fleet eighty ships, in each of which

"Were six score youths, Bœotia's noblest flower."

The district comprising the Copaic basin was at the time of the Trojan war, and probably long anterior even to that, one of the richest and most populous parts of Greece. Its wealth of myth would prove this, even if historic record were wanting. A circle with a radius of twelve or fifteen miles drawn around Copais will include more sites famous in romance and in history than almost any other place of like extent on earth. The Bœotian plain is nearly shut in by mountains the bare mention of whose names calls up a vast panorama of heroic figures, with a shadowy background of demigods and of gods reaching back into cloudland. Prominent above all is double-headed, snow-crowned Parnassus, with Delphi at its feet, its flanks scarred with caves and glens down which still leap the waters of Castaly. South of it, hiding the Corinthian gulf, stretches the range of Helicon, with its lovely valleys and ravines, home of Apollo and the Muses. Still farther south is Cithæron, whose groves echoed the revels of Bacchus and his train, and witnessed the punishment meted to Acteon by the virgin goddess. Under its shadow



Map of Lake Copais and Surroundings.

lies Platæa, its soil enriched with the blood of Mardonius and his Persians; and not far away Leuctra, fatal to Sparta's power, and Cadmean Thebes, home of Œdipus and of Antigone, birthplace of Heracles and of Dionysus, where Amphion sang and the Epigoni fought.

The Copaic basin itself and its surrounding hills are dotted with ruined cities. On the west shore of the lake Minyean Orchomenus, from whose colony of Iolcus sailed Jason and the Argonauts, still dominates the plain with its acropolis, its walls two miles in circuit. Its temple of the Graces, with its musical festivals, drew thither poets and singers from all the Hellenic world. Homer compares its wealth with that of the Egyptian Thebes, and so powerful was it that it held subject all the surrounding region until Heracles slew its king and made it vassal to Thebes. A little west of it is fatal Chæronea, where Philip of Macedon rang the deathknell of Greece, and where, two and a half centuries later, Sulla overthrew Mithridates. Between it and Helicon lies Lebadea, where Crœsus and Mardonius sought their fate from the oracle of Zeus Trophonius; and hard by is Coronea, famous for its temple of the Itonian Artemis and the Pambœotian festival. Near the lake is Tilphusium, with its fountain of Tilphusa, where blind Tiresias drank and died; Alalcomenæ, which claimed to be the birthplace of Athene; Haliartus, under whose walls Lysander fell; Onchestus, founded by Poseidon's son, meeting-place of the Amphictyonic Council; Acræphiæ, noted for its oracle of Apollo; and Medeon, Copæ, Holmones, Hyettus, Hyle, Peteon, and Ocalea, each famous in ancient story, and most of which sent ships and troops to Troy.

With all these evidences of pre-Homeric prosperity, one is tempted to ask, What has changed the conditions in this once favored and still fertile land, which to-day supports but a few thousand souls in scattered villages and hamlets? We find the answer in Strabo, who says: "The spot which the present Lake Copais occupies was formerly, it is said, dry ground, and was cultivated in various ways by the Orchomenians, who lived near it." This traditional account, about the only record of the prehistoric condition of the Copaic basin we possess, would seem to imply that it was kept dry artificially, and we find a partial explanation in other passages in which he describes certain subterraneous caverns and fissures through which the waters were carried off. "If the subterranean passages are stopped up, the waters of the lake increase so as to inundate and cover cities and whole districts, which become uncovered if the same or other passages are again opened." The memory of such a catastrophe, caused by the stoppage of the natural conduits, the result of seismic disturbances, as Strabo intimates, or from want of care in consequence of political

disturbances, is embalmed doubtless in the tradition of the Ogygean Deluge, Ogygea being the original name of Bœotia. A similar trouble must have occurred about the time of Alexander the Great, who appears to have contemplated the reclaiming of the

SUSTAINING WALL OF MASONRY.

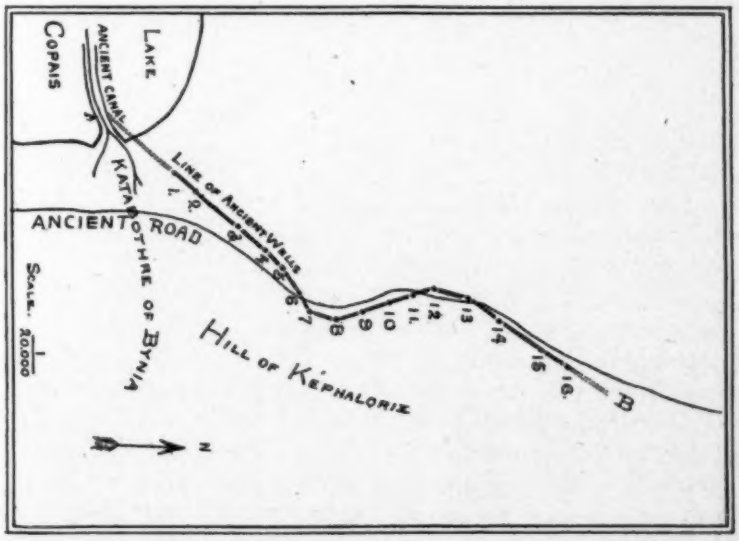
basin. Strabo says: "When the outlets were again obstructed, Crates, the miner, a man of Chalcis, began to clear away the obstructions, but desisted in consequence of the Bœotians being in a state of insurrection, although, as he himself says in the letter to Alexander, many places had been already drained."

These statements of Strabo would lead to the inference that the drainage of the basin by the ancients consisted only in keeping free from obstruction certain subterraneous passages through which the waters flowed to the sea; and this would probably have been the conclusion to-day but for the recent efforts of the Greek government to reclaim the submerged lands. These efforts, under the supervision of experienced engineers, have resulted in nearly draining the basin, and have led to the discovery of a complete ancient system of hydraulic works dating from so remote a period that all record or tradition of their construction has been lost. This system, so vast and comprehensive as to excite the wonder of modern engineers, taking into consideration the primitive appliances of the ancients, served to convert this now miasmatic basin into a fruitful plain, the home, a thousand years before our era, of a thriving and numerous population.

To give a clear conception of these ancient works and of the problems which the prehistoric engineers had to solve, it will be necessary to take a brief topographical survey of the region.

Lake Copais is the receptacle of the drainage of the valley of the Cephissus and of the plain of Chæronea, which is watered by the Hyrcinus, Permessus, Olmeus, Lophis, and other streams that descend from Helicon. All these streams flow in on the south and west sides, where the shores of the lake are simply a continuation of the adjacent plains; but on the north, east, and southwest, where the waters would naturally find an outlet to the sea, the banks form steep, rocky shores.

At the southeast extremity the lake ends in the Bay of Carditza, which is inclosed in a fold of Mount Sphingium, an offshoot of Helicon, and at the northeast in the Bay of Topolias or Kephalari, inclosed in Mount Ptoum. A depression in the flank of Sphingium is called the Hill of Carditza, and behind this, between it and Mount Ptoum, is a smaller lake, Hylice or Hylicus (Likeri). Further east, near the seacoast, lies Mount Messapium, with another small lake, called Paralimni, between it and Mount Ptoum. A similar depression in Mount Ptoum, east of the Bay of Kephalari, is called the Hill of Kephalari. The Copaic basin is



PLAN OF THE WELLS.

thus a natural *cul-de-sac*, with no apparent outlet; but the pent-up waters have worn fissures through the limestone rocks underlying the hills and formed for themselves, perhaps with some volcanic aid, as Strabo suggests, subterraneous outlets into the Euripus or channel of the sea between Bœotia and Eubœa. There are twenty-three of these subterraneous passages, locally called *katabothra*, but many of them unite underground and only four reach the surface on the east side of the hills. Of

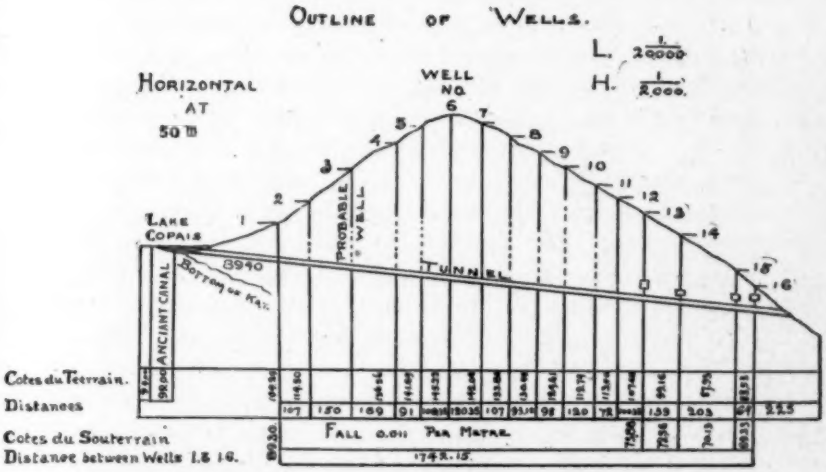
these four outlets, one passes southward under Mount Sphingium into Lake Hylice or Likeri, from which there is probably a subterraneous communication with Lake Paralimni and beyond it with the sea. The three others pass eastward under Mount Ptoum and its offshoots. The principal one, called the Katabothra of Bynia, with two openings on the lake side, passes under the Hill of Kephalari in a general direction from southwest to northeast, and opens on the east side of the hill in a large grotto about forty-five metres lower than its source, whence its waters flow through the deep ravine of the Valley of Larymna into the sea.

Strabo says that Lake Copais is three hundred and eighty stadia (about forty-seven miles) in circuit, but it differs greatly at different seasons, sometimes threatening to inundate the whole valley and sometimes forming only a series of fens overgrown with reeds—the auletic or flute reeds of the ancients, from which Pan's pipes were made. Its bottom, which is ninety-five metres above the sea, is a nearly level plain with a slight incline toward the east and a little elevation in the center. Modern travelers, from the time of Sir George Wheler upward, have noted on both its north and its south shores the remains of ancient dykes, in some parts re-enforced with masonry. These dykes, in several places still used as roads, have generally been considered as ancient causeways, means of communication in times of flood between the towns on the banks; but they are now shown to be parts of a system of drainage canals by means of which the superfluous waters of the basin were led to the katabothra under the hills.

The recession of the waters through the efforts of the present engineers has shown that there were three main canals through the entire length of the lake, branching at their western ends into subsidiary canals or feeders for collecting the various tributary waters. These main channels, which for convenience' sake we will call the north, middle, and south canals, are constructed partly of excavations and partly of a series of dykes or causeways, strengthened where necessary by walls of cyclopean masonry. The north canal, the most carefully and solidly constructed of the three, receives the waters of the Cephissus and conducts them into a common channel with those of the Melas, a stream which, rising near Orchomenus, is navigable almost from its source. After their junction the waters flow through a bed, formed on the north by the rocky shore of the lake and on the south by a massive embankment re-enforced by masonry, behind the island of Topolias, the site of ancient Copæ. Thence the canal leaves the shore and, embanked on both sides, crosses the Bay of Kephalari and conducts its waters into the natural fissures under the mountain. This double embankment, though partly ruinous, is still plainly traceable.

The middle canal, constructed to receive the waters of the Hyrcinus, traverses the center of the lake and connects near the east end with the south canal. Unlike the north canal it is made wholly by excavation, the earth thrown out forming its banks, and it is nowhere strengthened by masonry. The alluvial deposits from the stream have nearly obliterated it in parts, but its course is easily traceable and in some places, especially near the western end, the works exhibit formidable dimensions, showing in cross-section an excavation of more than a hundred metres to the lineal metre.

The south canal, for the reception of the waters of the Permessus, Olmeus, and other small streams from Helicon, starts from the southwest end of the lake, and, following the south bank



Profile following the Line of the Wells.

past Tilphusium and Haliartus, rounds the cliffs of Mount Sphingium, a little distance from the shore, and unites probably with the middle canal in the bay of Carditza. The two thus united finally join the north canal in the Bay of Kephalari, and the waters of all three are then conducted in a single channel across the bay and into the several katabothra at its foot. Although most of the first part of this canal is gone, parallel embankments, more than fifty metres apart, inclosing an excavation, are to be seen in places, occasionally strengthened with stone work. At the junction of the several canals especially, the work has been executed with great care, the dykes being sustained by cyclopean walls as solid and probably as ancient as those at Mycæne and Tiryns. Although the main waters of the south canal were poured into the middle and finally into the north canal, all along its course part of their volume was deflected

through branch canals into the several katabothra along the east shore. Indeed, the details of the system are much more complicated than are indicated by this brief description, and comprise, in addition to the main canals, many smaller subsidiary ones both for feeding and for draining them. When we take into consideration the difficulties attending excavation in so marshy a soil, and of transporting across it the heavy stones for the embankments, and note the immensity of the plan and the thoroughness and solidity of its execution, we are moved to admiration for the engineers who conceived and built the great works which rendered this part of Bœotia habitable before the dawn of history.

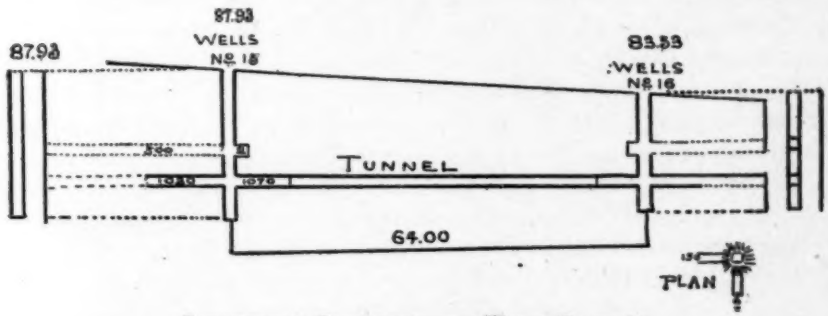
The system involved, too, the clearing and the keeping open of the katabothra, which were liable to become obstructed and sometimes to be entirely closed by the caving of the soil and rocks, and there are many evidences of ancient efforts to enlarge and deepen them. That these efforts were not always successful is proved by the traditions of early inundations, referred to before, caused probably by earthquakes, but which were attributed to the efforts of Hercules when he espoused the cause of his native Thebes against Orchomenus. To guard against the recurrence of a similar catastrophe, the ancient engineers planned several cuttings and tunnels through the hills, which, if they had been carried to completion, would have rounded out the original design and accomplished what the Greek Government is to-day trying to effect—the thorough reclamation of the basin and its protection from any contingency of flood. On the southeast shore of the lake are vestiges of an immense cutting, thirty metres deep, through the Hill of Carditza toward Lake Hylicus, and beyond that traces of works to connect Hylicus with Paralimni, and the latter with the sea. Across the Hill of Carditza, too, are a series of excavated shafts marking the line of a tunnel through the hill constructed with an object similar to that of the cutting—to convey the waters to the sea through the smaller lakes; but the shafts are now filled up and there are no indications that the work was ever completed.

This route is the one adopted by the modern engineers, who, by a tunnel through the Hill of Carditza, not far from the line of the ancient tunnel, seek to carry the waters into Lake Hylicus, thence into Paralimni, and finally through another tunnel into the sea. There is also a plan to deflect a portion of the waters for use in irrigating the plain of Thebes.

A still more ambitious undertaking of the ancient engineers was an attempt to penetrate the Hill of Kephalari at the northeast end of the lake by a tunnel more than a mile and a quarter long. This hill, a depression on the flank of Mount Ptoum, has a maximum height of one hundred and forty-seven metres above

the sea and fifty-two metres above the bottom of Lake Copais. Across this depression, from near the openings of the Katabothra of Bynia in the Bay of Kephalari, runs a line of ancient wells or shafts in a general direction from southwest to northeast, not in a straight line, but following the contour of the hill, ending on the east side not far from where the katabothra opens into the Valley of Larymna. There are sixteen of these wells, cut through the hard, gray limestone of which the mountain is composed, and carefully squared, with an average horizontal section of three to four metres. The first shaft, on the west side, is five hundred metres from the lake; the sixteenth, on the east side, two hundred and twenty-five metres from the opening. The wells are at an average distance from each other of about one hundred and sixty metres, and the whole distance from opening to opening is about twenty-four hundred metres.

These shafts are not mentioned by any ancient writer, but have been frequently described by modern travelers, notably by Forchhammer, who has given the most complete description



LONGITUDINAL SECTION BETWEEN WELLS 15 AND 16.

of them. The general conclusion in regard to their object was that they were designed to facilitate the clearing of the katabothra when, from caving or other causes, it had become clogged; but in 1846, M. Sauvage, who examined the shafts critically and cleared several of them, came to the conclusion that they were part of a tunnel scheme, and were sunk with the purpose of giving many points of attack to the workmen engaged in excavating the tunnel instead of a single one at each end. To the ancients, ignorant of the use of explosives, this was of great importance, for the cutting with hammer and chisel was arduous and slow. Even with these numerous shafts, which must themselves have been a difficult undertaking, the excavation of so long a tunnel would have cost the labor of many years. In 1882 several more were cleared and thoroughly examined—the first and the second on the west slope toward the lake and the thirteenth, fourteenth, fifteenth, and sixteenth on the east slope of the hill. The first

and the sixteenth wells are each eighteen metres deep, while the sixth, at the summit of the hill, is sixty-six metres deep.

Sauvage concluded that the tunnel had been left unfinished, which later examinations have fully proved. The fact that the first and second wells contain water indicates that it had been completed on the lake side for at least five hundred metres. The exploration in 1882 of the thirteenth well, whose orifice is at an elevation of 107·68 metres, discovered, at a depth of 28·35 metres, a horizontal gallery, 1·60 metre wide and 1·65 metre in the axis,

Outlet of Katabothra of Bynia.

cut in each direction about six metres. At 2·15 metres below this was found a second gallery of the same section, cut in the same direction, and the shaft was excavated 2·70 metres farther down, probably for use as a drainage well, ending in a level bottom, its total depth being 36·50 metres. The fourteenth, fifteenth, and sixteenth wells, at decreasing altitudes, show a similar interior disposition, save that in the fourteenth the gallery has been but slightly advanced and there is no drainage well. In the fifteenth shaft, which has a total depth of 78·93 metres, the upper gallery is cut to a depth of five metres on the west and two metres on the east, and the lower one 10·30 metres on the west and 10·70 on the east, while the well is 4·70 metres deep. In the sixteenth well the up-

per gallery is cut only two metres on the west and none on the east, the lower one seven metres on the west and 7·30 on the east, with a well of 4·20 metres in depth. In the last shaft the two galleries are three metres apart, and in the fifteenth only 2·15 metres, thus showing a tendency to diverge. This would seem to prove that there was no intention of ultimately uniting the two galleries by cutting away the rock between. It is more probable that the upper galleries were begun first, and that some consideration induced the engineers to change the grade and give a greater fall to the tunnel. The mean section of the lower gallery is about two metres, the fall from Copais to its mouth is 0·011 metre to the lineal metre, and its total length completed would have been about twenty-four hundred metres. The cutting of so long a tunnel through so hard a rock with the primitive means at the disposal of the ancients shows not only an audacity of plan and a persistent obstinacy in execution, but also a skill in the art of the engineer and the miner that would be no discredit even to the present age.

Who were the authors of these great works concerning which history is silent and which are themselves their only witnesses? Perhaps this question will never be satisfactorily answered. Leake and others attribute all, the wells of Kephalari as well as the canals, to the Minyans, while some believe that Crates of Chalcis was responsible for the parts exhibiting the most engineering skill, and others ascribe them to some of the earlier Roman emperors. Curtius, in his Die Deichbauten der Minyer, a paper read before the Berlin Academy in 1892, carefully distinguishes two distinct works and methods of work: (1) the utilization of the natural exutories toward which the waters were led by means of dykes and canals, and (2) the formation of an artificial emissary to draw off either all the water or the excess of water from the lake. The first, grand and simple in design, he attributes to the primitive or Homeric age; the last, marked by careful calculation and executed with the skill of the practiced engineer, he ascribes to the age of Alexander, and presumably to Crates, the only name mentioned in connection with it. Unless the future shall bring to light some inscribed stone or other monument which shall give us definite information concerning the promoter who planned or the engineer who executed these vast works, we shall have to accept the judgment of Curtius and give the credit of them to Crates, the miner of Chalcis.*

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* I am indebted for much of the material in this article to two articles, by Michel L. Kambanis, in the Bulletin de Correspondance Hellénique, published in 1892 and 1893, entitled Le Desséchement du Lac Copais par les Anciens; and to an article by Dr. Alfred Philippson, in the Zeitschrift der Gesellschaft für Erdkunde zu Berlin, 1894, entitled Der Kopais-See in Griechenland und seine Umgebung.

SIR JOHN LUBBOCK AND THE RELIGION OF SAVAGES.

By The Very Rev. JAMES CARMICHAEL,
DEAN OF MONTREAL.

THE question as to whether there are races or tribes on the earth entirely without a religion is one that demands on its threshold a definition of the word "religion." That it can not fairly be tied down to advanced forms of belief seems apparent, and hence the necessity of falling back on the original meaning of the word—i. e., that of binding fast the human mind to a sense of the obligation which it owes to supernatural powers. Civilization, education, may make this obligation clearer, and a professed revelation may bring before the mind the attributes of the powers to whom the obligation is felt to be due; but, as long as the obligation is mentally present and the force of the obligation fashions to any important extent not only personal but tribal conduct, so long in fairness we seem bound to acknowledge the religiousness of such persons or tribes, even though such religiousness may never create a theology, or a cut-and-dried system of doctrinal truths.

If this definition of religion be accepted, then it may boldly be asserted that, as far as is known, there is not a tribe on the face of the earth without a religion; indeed, it may be said that, of all human ideas that in any form influence the mind and conduct of man, there is no idea so widespread and influential as the religious idea. To us, living as we think in the light of reason or revelation, such religious ideas may appear unworthy of the name, but when we consider that the most indefinite belief may —and indeed, as a rule, does—lead a savage to fashion his conduct in accordance with what he believes to be the will of higher powers, as far as personal actions are concerned, he stands on exactly the same platform as the most devoted believer in natural or revealed religion.

In such cases, as far as the use of the word religion is concerned, it matters little what the mental idea of the higher power or powers believed in may be. That idea may center itself in a supreme God, or a Trinity of gods, or a multitude of gods, or in good and evil spirits, or in gods dwelling temporarily in common things, or in the spirits of dead ancestors or friends, but as long as any one of such powers demands and receives obedience, and as such obedience fashions life, the most indefinite spirit is practically as powerful as the most clearly defined god. And the same may be said with reference to forms or methods of worship. If the worship, whatever form it takes, is regarded as a necessity,

or a privilege, or a charm, or a preservative against evil, or an engine of evil against others, it matters little as to whether it be rendered to God, or spirit, or goblin, or devil, because, whatever the worship is rendered to, the worshiper honestly feels he is in the presence of one whose power is needed to aid him in his life or work, and without whose help he can not be successful.

The chief contestant of universal religiousness has been, and is, Sir John Lubbock, although the force of circumstances has driven him of late to change his mode of presenting his contest. In the earlier editions of his Prehistoric Times he claims that "almost all the most savage races" are "entirely without a religion," "without idea of deity," and that the "almost universal testimony of travelers" supports this assertion. In his fifth edition (1890) he still claims that "almost all the savage races" are "entirely without a religion, without idea of deity," but he proceeds to define what religion is not. It is not "a mere fear of the unknown," it is not "a more or less vague belief in witchcraft," it is something "higher" than all this; and if this "higher estimate" of religion be adopted then his original assertion remains true, that "many, if not all, of the most savage races" are "entirely without a religion, without any idea of a deity." The object of this definition of the word religion is plain. Between the years 1869 and 1890 evidence as to the religiousness of savage tribes kept pouring in from all quarters of the world; the list of unbelieving savages made public by Sir John Lubbock in 1869 was seriously interfered with, and the position taken by Waitz, that "the religious element, so far from being absent from uncultured peoples, influences their whole conception of Nature," was powerfully substantiated. Then Sir John Lubbock repairs his damaged argument, working with the implements of the most bigoted member of an old-fashioned missionary society. He defines religion as something spiritually "higher" than the belief of a Hottentot or Eskimo, and then repeats his assertion of 1869 that "all of the most savage races are entirely without" such "a religion."

Sir John Lubbock's method (pursued consistently through all editions) of adducing evidence in favor of his assertion as to the non-religiousness of savage tribes is palpably unreliable, as far as he professes to give the full intention of the authors quoted. Bates, Caillie, Ross, and others certainly say all that Sir John Lubbock quotes, but they say much more; and what is left unquoted often throws a totally different light on each quotation. He quotes Caillie as follows: "I tried to discover whether the Foulahs (of Wassoula, in central Africa) had any religion of their own; whether they worshiped fetiches, or the sun, moon, or stars; but I could never perceive any religious ceremony

among them."* Here Sir John Lubbock plainly means to teach, on the authority of Caillie, that the Foulahs were not even fetich-worshipers; that they were positively without any religion of their own. But if he had read Caillie more carefully—read the context as well as the text—he would have discovered that the Foulahs and kindred tribes were idolaters; for that well-known explorer goes on to say: "Wassoula is a country inhabited by idolatrous Foulahs; they carry on little traffic, and never travel; their idolatry would indeed expose them to the most dreadful slavery if they did. . . . They have each several wives, like all other idolaters." It is plain that Caillie here makes a distinction between higher forms of worship and the grosser worship of images. He sought for the higher form of worship, and found no trace of it, but he evidently found the grosser form, or evidence of it. And it was this grosser form of idolatry that made it dangerous for the Foulahs to travel outside of their limits; for, if they had done so, they would have come into contact with Mohammedanism, pledged to the extirpation of idolatry, and in many countries to the enslavement of persistent idolaters.

The same lack of thoroughness in quotation is noticeable in Lubbock's treatment of the testimony of Bates as to the Brazilian Indians. He says, "According to Bates, 'none of the tribes on the upper Amazons have an idea of a Supreme Being, and consequently have no word to express it in their language.'" This quotation is perfectly correct, but it does not imply what Sir John Lubbock is seeking to prove—namely, that "almost all the savage tribes are entirely without a religion." It simply affirms that Brazilian Indians do not believe in a Supreme Being—an affirmation that might fairly be made with reference to many tribes whose beliefs are very apparent. But in no sense can Bates be quoted as a witness to the absence of religious belief among Brazilian Indians; his testimony runs in the opposite direction. "The mind of the Indian," he writes, "is in a very primitive condition. He has no idea of a Supreme Being, but at the same time he is free from revolting superstitions, his religious notions going no further than belief in an evil spirit, regarded merely as a kind of hobgoblin who is at the bottom of all his failures in fishing, hunting, and so forth."† In this testimony the word "hobgoblin" depreciates in our minds the character of this supernatural being, but few if any savages have such a word in their mental vocabulary. Few if any evil spirits worshiped by savages unite in them the clumsiness and trickery of a hobgoblin; their evil, awful spirits are terrors, entering into all as-

* Travels to Timbuctoo, vol. i, p. 303.

† Bates's Life in the Amazons, vol. ii, p. 137.

pects of life, filled with malignant purposes, and demanding constant worship to propitiate them. Thus the Indians of Carácas, in Venezuela, north of Brazil, while believing in good spirits, render all their worship and offer all their sacrifices to a great evil spirit, and do so because they feel that the good spirits are naturally friendly and do not require to be lured on to perform beneficent actions.

Sir John Lubbock's quotation from Ross as to the Eskimo is equally lacking in thoroughness. Here is his quotation in full: "Speaking of the Eskimo, Ross says: 'Ervick, being the senior of the first party that came on board, was judged to be the most proper person to question on the subject of religion. I directed Sacheuse to ask him if he had any knowledge of a Supreme Being; but, after trying every word used in his language to express it, he could not make him understand what he meant. It was distinctly ascertained that he did not worship the sun, moon, stars, or any image or living creature. When asked what the sun or moon was for, he said, to give light. He had no knowledge or idea how he came into being, or of a future state; but said that when he died he would be put into the ground. Having fully ascertained that he had no idea of a beneficent Supreme Being, I proceeded, through Sacheuse, to inquire if he believed in an evil spirit; but he could not be made to understand what it meant." . . . "He was positive that in this incantation he did not receive assistance from anything; nor could he be made to understand what a good or evil spirit meant.'"

This quotation, standing as it does alone, is unintentionally unfair to Ross, for Sir John Lubbock either did not notice, or has forgotten to quote, words used by Ross elsewhere with reference to the Eskimo, although such words are very important. He says: "Although there is no proof whatever that this people have any idea of a Supreme Being, or of a spirit, good or bad, the circumstance of their having conjurers, and of their going to the moon after death, are of a nature to prevent any conclusion from being drawn to that effect; especially as it must be evident that our knowledge of their language was too imperfect to obtain the whole of their ideas on the subject."*

It scarcely required these honest words of Ross, written, no doubt, to prevent mistakes being made, because in the quotation as given by Sir John Lubbock nothing can be clearer than the fact that Ervick did not understand the questions put to him. "I directed Sacheuse to ask him if had any knowledge of a Supreme Being, but after trying every word used in his own language to express it, he *could not make him understand what he*

* Ross, Voyage of Discovery.

meant." "I proceeded, through Sacheuse, to inquire if he believed in an evil spirit; but he *could not be made to understand what it meant. He could not be made to understand* what a good or evil spirit meant." The probable fact of the matter was that Sacheuse could not speak the Eskimo dialect of those he was catechising. If he did not speak to them in "an unknown tongue," he certainly did in an unfamiliar tongue, the result being a general misunderstanding all round. If Sacheuse had been able to ask his listeners, "Do you believe in a benevolent Creator called 'Torngarsuk' or 'Anguta'?" it is most likely he would have received his answer in the shape of a definite affirmative.

"On Damood Island, between Australia and New Guinea," writes Sir John Lubbock, "Jukes could find no traces of any religious belief or observance."* This certainly is not to be wondered at, as he only spent part of a day there (March 21, 1845), and the effort at interchange of views was singularly weak, as the natives knew only a few words of English, and the English visitors knew nothing of the native language. The portion of the day spent on the island was taken up with bartering with the natives on the seashore, and during part of this time Captain Blackwood and Mr. Jukes struck "off for a walk across the island," in company with one of the natives. During this walk Jukes noticed a superior kind of house which he thought might have been a temple or a place for depositing the dead, or a chief's house, but "they could not make out which," for the simple reason that they could not communicate with their guide.

The case of the Aru Islanders is a striking instance of Sir John's method of quotation. Here are his words: "Mr. Wallace, who had excellent opportunities for judging, and whose merits as an observer no one can question, tells us that in the Aru Islands he could find no trace of a religion; adding, however, that he was but a short time among them."† Mr. Wallace, however, does not agree with Sir John Lubbock as to his "excellent opportunities for judging," for he says, "I could not get much real knowledge of the customs of the Aru people during the short time I was among them." The natives, he tells us, when in contact with foreign races were reserved and taciturn; and that as he could not speak the Aru language, and the natives had "an imperfect knowledge of Malay," he could not "make out very clearly" what at times they said. "I saw no signs of any religion" may mean that, in his rambles as a naturalist through the country about Wanumbai, he never came across anything like a temple or altar. Indeed, no one can read Mr. Wallace's singularly interesting book without noticing that he

* Jukes, Voyage of the Fly, vol. i, p. 164.

† Wallace, Malayan Archipelago.

apparently made no well-sustained effort at religious investigation at Aru or anywhere else.

The following gives evidence of further carelessness in quoting: In writing of certain tribes in the country of Karaque in Africa, Sir John says, "Captain Grant could find no distinct form of religion in some of the comparatively civilized tribes visited by him."* What Captain Grant says is this: "We could not trace any distinct form of religion among this interesting race, but there were certain indications or traces of Jewish worship." Then Captain Grant tells us that the king had "many superstitions"; that he "combined in himself the offices of prophet, priest, and king"; that on the feast of the new moon he "assumed the priestly garb"; and that a younger brother of his "consulted daily with the gods," and was considered a greater prophet and priest than his royal brother.

"According to Burchell," writes Sir John, "the Bachapins (Kaffirs) had no form of worship or religion. They had no belief in a good deity, but some vague idea of an evil being."† One would glean from this quotation that the only approach to religious thought among the Bachapins consisted of a vague belief in an evil spirit, whereas Burchell distinctly states that they possessed a religion, although he believed they had no "form of worship" or "religion." What he says is this: "Their religion may be characterized as an inconsistent jumble of superstition and ignorance, among which no signs were to be discovered of its having ever been derived from any purer source, or that it was aught else than the offspring of barbarous and uncultivated minds." He then further states: "The superstition of the Bachapins—for it can not be called a religion (although he himself had called it so)—is of the weakest and most absurd kind. These people have no outward worship, nor, if one may judge from their never alluding to them, any private devotions; neither could it be discovered that they possessed any very defined or exalted notion of a supreme and beneficent deity, or of a great and first creator. Although they do not worship a good deity, they fear a bad one, whom they name Mooleemo, a word which my interpreter translated by the Dutch word for devil. They also believe in amulets as preservatives against evil, in lucky and unlucky omens, in witchcraft and sorcery."

Now, if language means anything, Burchell's testimony may be summed up thus: "The Bachapin Kaffirs possess a religion scarce worthy of the name, consisting of witchcraft and sorcery and the recognition of an evil spirit called Mooleemo. Their no-

* A Walk across Africa, p. 145.

† Travels in South Africa, vol. ii, p. 550.

tions with regard to a supreme and beneficent deity, or of a great and first creator, are indefinite and degraded; they have no outward worship, and they never alluded to their offering private devotions." All this, however, implies a great deal more than Sir John's bare statement, "According to Burchell, the Bachapins (Kaffirs) had no form of religion and worship," etc.

"Some of the Australian tribes," writes Sir John, "are said to have no religion," and he gives as his authority for this statement a reference to Collins.* Sir John does not quote literally from Collins; he sums up his testimony, but his mode of doing so is scarcely satisfactory. For Collins, while stating that the Australians worshiped neither sun, moon, nor stars, or any object, admits that those he came in contact with had "some idea of a future life"; that the greater number of them believed that after death they "went to the clouds." Conversing with Ben-nil-long as to where the black men came from, his answer was, "They came from the clouds, and when they died they returned to the clouds—Boo-row-e," and he endeavored to make Collins understand that when the black men died "they ascended as little children." Collins further states that these Australians have ideas of the distinction between good and bad, and of right and wrong, but their knowledge of the difference between right and wrong never extended beyond their existence in this world, and their ideas about the future state had no influence on their lives and actions—an assertion that might, unfortunately, be truthfully made in connection with the religious views of many professing Christians.

In dealing with the lake tribes of Central Africa Sir John gives Burton as his authority for stating that some of them "admit neither God, nor angel, nor devil." His words are: "Burton also states that some of the tribes in the lake districts of Central Africa 'admit neither God, nor angel, nor devil.'"† This quotation is very meager, and its meagerness is scarcely just toward Burton. Burton is describing fetichism, which he says "admits neither God, nor angel, nor devil"—a statement certainly open to argument—and then he proceeds as follows: "Fetichism," he writes, "is the adoration, or rather the propitiation, of natural objects, animate or inanimate—to which certain mysterious influences are attributed. Though instinctively conscious of a Being beyond them, of a first cause to every effect subject to their senses, the Africans have as yet failed to grasp the idea, in their feeble minds it is an embryo rather than an object, at the best a vague god, without personality, attributes, or providence. They call that being Mulungu—the Ahlunga of the Kaffirs, and

* English Colony in New South Wales, p. 354.

† Transactions of the Ethnological Society, New Series, vol. i, p. 323.

the Utita of the Hottentots. The term, however, may mean a ghost, the firmament, or the sun."

Sir John's method of quotation sometimes implies total unbelief without asserting it, as in his quotation from Father Dobritzhoffer with regard to the Abipones. The words quoted are, "The whole language of these savages does not contain a single word which expresses God or a divinity."* These words taken alone imply atheism, or something akin to it, but in common fairness they should not be taken alone, for Dobritzhoffer tells us that the Abipones hold a somewhat defined faith. They believe in an evil spirit called Groaperikie—i. e., Grandfather—who is represented in the heavens by the Pleiades. In the month of May, on the reappearance of the constellation, they welcome their Grandfather back with joyful shouts, as if he had recovered from sickness, and with the hymn, "What thanks do we owe thee! And art thou returned at last? Ah! thou hast happily recovered." Next day they go out to seek honey to make mead, and as soon as that is prepared they assemble in one place at the setting of the sun to make public demonstration of gladness. Dobritzhoffer further tells us that the Abipones, and indeed all the nations in Paraguay, believe in a system of conjuring, the conjurers being invested with great powers by the evil spirit Grandfather. "From their custom of calling up the shades of the dead, we may deduce that they believe in the immortality of the soul, as may also be collected from their rites and conversation. The other people of Paraguay hold the same opinion as to the immortality of the soul. The jugglers perform the office of priests."

Colden's testimony as to the "Five Nation" Indians of Canada is presented by Sir John Lubbock in such a way as to imply far more than Colden intended. Sir John says, "Colden, who had ample means of judging, assures us that the celebrated 'Five Nations' of Canada had no public worship or any name for God."† Colden certainly does tell us that "they have no kind of public worship," but he plainly never meant to imply that they had no idea of God because they could not express that idea in one word. What he says is this: "I am told they have no radical word to express God, but use a compound word, signifying the Preserver, Sustainer, or Master of the universe."

When one considers the influence that Sir John Lubbock's Prehistoric Times has had on the reading public, and the shock that his statements as to the utter irreligiousness of certain tribes gave many of his readers, one feels inclined to question his authority as a teacher, when his quotations are submitted to the simple test of verification. One wonders how such a man as Sir

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* Account of Abipones, vol. ii, p. 57.

† The Five Nations of Canada.

John Lubbock could gather into the compass of a few concluding pages of a really great work such a tissue of misguiding information. His character testifies that he could not do so intentionally, and it is not likely that his religious views are of such a nature as to lead him to rule outside of the pale of religious belief all who do not use a systematic form of worship, or do not acknowledge in creedlike fashion the person of the Divine Being. The only feasible explanation seems to be found in that peculiar blindness which all students know is apt to fall on the eyes of those who are striving to gather material to support a pet theory. In such cases, as the eye runs down page after page of close print, seeking for a scrap of information here or there, it naturally selects the sentence favorable to the theory, and passes over or does not see unfavorable sentences that may contain much more valuable information. Where such a method of investigation is pursued as a basis for quotation, a singularly strong case can commonly be presented on behalf of the theory; above all, where the works relied on have, on account of their age, passed out of general circulation. But such a method is palpably unscientific, being calculated to give a partial view of the point at issue, whatever that may be. If Sir John Lubbock, in the hurry of a busy life, has not fallen under this common temptation, then one knows not how to explain the extraordinary fact that one of the keenest minds in the English scientific world has so persistently left undone what he ought to have done, and done what he ought not to have done, as he gave to the public quotations from other writers.

Another strange fact is apparent. Prehistoric Times has gone through five editions, the first being published in 1859, the second in 1869, and the fifth in 1890. During this period of time investigations into the habits, customs, and religions of isolated and barbarous tribes have been very widespread, and the harvest of information reaped has been very large. But greater light has made no change in Sir John's authorities. Jukes, Collins, Burchell, Caillie, Dobritzhoffer, and Catlin maintain their time-honored position, and the harvest of modern investigation might never have been reaped, as far as Sir John is concerned. It is not the object of this article to enter into this harvest field, though the subject is in every way interesting and the facts close to hand. But a noble work lies before Sir John Lubbock, namely, that of reviewing his original statements in the light of modern investigation, and proceeding to prove the position that there is not a well-authenticated case of a single tribe on the face of the earth wholly destitute of the religious idea.

AMONG THE CANNIBAL ISLANDS.

By LAENAS GIFFORD WELD.

SPREAD out before you a chart of the South Pacific—one upon which are set down the many details useful to the navigator of this strangely interesting region. Besides the intricate labyrinth of islands, reefs, rocks, and shoals which are scattered over its surface, there are recorded the variations of the compass, the directions of the ocean currents, and the results of countless soundings. Running your pencil through all the points on this map for which the indicated depth is fifteen hundred fathoms or thereabouts, you will be able to trace out an irregular and more or less interrupted band, extending from the East Indian seas nearly to the coast of South America. Within the area thus marked out the sea is comparatively shallow; so that, were its bed to be elevated some thousands of feet, we should see emerging from its surface a vast continental area, bordered on the north and south by open seas.

We are told that such a continent once really existed, but that for thousands of years it has been slowly subsiding. The coral polyp has all this time been building up the countless reefs and atolls of this region, keeping their summits flush with the surface of the sea as the subsidence has gone on; so that here, instead of the dull monotony of an ocean desert, we have one of the most striking physical features of the globe. There are volcanic masses among these coral islands which, rising some few thousand feet above the level of the great barrier reefs that surround them, may be looked upon as remnants of this vanishing continent of the Pacific. Among these ancient landmarks none are of more interest than the great Fiji group of islands.

Until within quite recent years the word Fiji was regarded as a synonym for all that is barbaric; and if that epithet, "King of the Cannibal Islands," ever had any real claimant, it must have been in the person of Thakombau, the native potentate who played so important a part in the history of Fiji from the time of its first settlement by Europeans till it was formally annexed by Great Britain.

This regenerate old cannibal had spent the first forty years of his life in wars with his neighboring chiefs and in the practice of the most horrible barbarities. The strangling of his own mother and of his father's four other wives was only a part of the usual ceremony attending the assumption of the title of *Tui Viti*, or King of Fiji. Thakombau was, however, not hostile to the Wesleyan missionaries who had established themselves within his domain; but, while he listened respectfully to their remon-

strances, he remained a determined heathen. This continued so long as he was prosperous; but when, in 1854, tribe after tribe had successfully rebelled against him, he began to listen more favorably to the counsels of the Christians. On the 30th of April of that year he gave orders that the great drums at his capital, which had been used till then to summon his people to cannibal feasts, should be beaten to call them together at the mission house to worship the true God. Two years later, having remained true to his new faith, he was united in Christian marriage to his favorite wife, and they were together baptized.

It was the same king who, at a later period, finding himself a mere puppet in the hands of foreigners, who had formed themselves into a government, of which he was the nominal head, brought about a general appeal from the most powerful chiefs to England's Queen for protection—an appeal which was, in 1874, listened to with favor. Upon this occasion Thakombau sent to Queen Victoria his favorite war club, which he himself styled "the former, and until recently the only known, law of Fiji."

The territory thus acquired by the British Empire comprises over two hundred islands of various sizes, some seventy-five of which are inhabited. The largest, Viti Levu, is oval in form, and has an area nearly equal to that of the State of Connecticut. Vanua Levu, lying to the northeast of Viti Levu, rather exceeds Delaware in size. Between these two islands, which are by far the largest in the group, is a channel some thirty miles in width; but the sea here, as well as over an immense area to the north, is so full of coral patches that navigation is exceedingly dangerous. The southern shores of the islands are more accessible, and afford many excellent harbors, of which that of Suva, the English capital, on the southeast coast of Viti Levu, is the best.

The study of the difference in the character of the northern and southern aspects of the larger islands affords an interesting lesson in physical geography. Thrust upward into the currents of the southeast trade winds to a height of over four thousand feet, the mountain ranges act as huge condensers, precipitating in torrents of rain the moisture which these currents have absorbed from the open sea. This condensation takes place principally as the winds blow up the southern mountain slopes, so that comparatively little rain falls upon the north side of the islands. The largest streams, therefore, flow back down the southern slopes to the sea, where they discharge immense volumes of fresh water. As fresh water is fatal to most species of coral polyps, we find here, along the southern coast, comparatively few of those dangerous reefs that fringe the islands on the north.

The fertility of the soil, which in the valleys and on all the southern slopes is thoroughly saturated with moisture, is quite

equal to that of other similar regions. In the dense tropical forests, which cover large areas, tree ferns, screw pines, and a multitude of other strange forms contend with one another for the light of day, while affording nourishment to an immense variety of epiphytic mosses, lianas, and ferns, which connect the larger stems and branches with an almost impenetrable network of green.

There are few really indigenous species of animals; rats and flying foxes being the only mammals. As to the others now found here, the names by which they are known point to their European origin; thus we have *seepi* (sheep), *goti* (goat), *collie* (dog), *pussi* (cat), etc. Even the hogs and fowls which run wild in the jungles came originally from the Friendly Islands, where they were introduced by the early navigators.

Living in such a little world as this, the Fijians were of necessity much in advance of the races inhabiting the neighboring Pacific islands. The struggle for securing and holding this fair domain must of itself have led to its possession by a superior race. We find evidences of this superiority not only in the splendid physical development of the Fijians, but also in their relatively advanced religious notions and in their rather elaborate system of mythology. One traveler has likened this people, in some respects, to the primitive Greeks. If we compare the petty maritime enterprises celebrated in Fijian song and story with those recorded by the early Greek poets, we may imagine the difference to be in some measure due to the difference in character of the two archipelagoes which were their respective scenes of action. Upon taking the trouble to translate certain books of Homer into Fijian it was found that their recital was listened to by a company of these untutored savages with the most appreciative attention. This fact certainly speaks well for the mental quality of the race. The one foul blot upon the character of the Fijians was their cannibalism; but, in view of the readiness with which they have abandoned this practice, now that animal food can be easily obtained, we must hold Nature responsible, not only for this curse, but also for the many other barbarities attending it.

The national character of Fiji finds its best expression in the songs once common among the natives, but now, under Christian influences, almost obsolete. These songs or *mekkés*, as they are called, generally recount the story of some ancient hero, of some military campaign or naval expedition, or perhaps of a peaceful fishing excursion. They are generally sung of evenings by the men only, who assemble for the purpose in one of their long, low huts. Here they sit in solemn state on mats laid upon the ground, the only light being that of a smoky fire in one end. According

to Major Abercrombie, an eyewitness of the ceremony, one man begins the chant alone; a second soon joins him, then a few more, till finally all present have taken it up, accompanying the wild music by much pantomime and earnest gesticulation. The time is beaten upon a wooden drum by one of their number, and is occasionally accentuated by a general clapping of the hands. After a certain climax has been reached, the music stops quite abruptly with one loud clap.

Yangona, the national beverage, is then served. This liquor is brewed with much formality, accompanied by low chanting. The great wooden bowl having been brought into the center of the room, the operator in charge sits down cross-legged before it. The yangona root is grated (it was formerly chewed by young men selected for the purpose) and deposited in the bowl, the inside of which has, from long use, become covered with a beautiful purple enamel. The requisite number of cocoanut shells of water are measured out and poured over the grated root, the whole being stirred to the music of a solemn chant. The floating particles of the grated root are collected and removed by means of a net of hibiscus fibers skillfully handled by the person in charge of the brew. The liquor thus prepared is handed round in cups of cocoanut shell, the chief being the first to drink. Taking the cup between his two palms, he slowly swallows its contents without removing it from his lips, while the onlookers join in a measured clapping of the hands. When the cup is finally thrown down with a spinning motion, to show that it is empty, all unite in the chorus, "*A matha, a matha*"—it is finished. The others now drink in a certain order of precedence. The liquor is of a dirty yellow color and has a bitter, aromatic taste, not altogether disagreeable. Used in moderation, it acts as a stimulant, but if indulged in too freely a temporary paralysis of the lower extremities follows, and the victim, while perfectly rational, reels and staggers as if drunk.

It is at these meetings around the yangona bowl that the numerous legends and fables of which the Fijians were passionately fond have been handed down in song from generation to generation. As a specimen of these mythical tales we give one which has been rescued from oblivion by the Rev. Thomas Williams and recorded by Mrs. C. F. Gordon Cumming in her At Home in Fiji. It tells of a gigantic bird called "Duck of the Rock." This monster carried off Tutu Wathi Wathi, the beautiful wife of the god Okovo and sister of Rokoua. The two gods gave chase in a large canoe, and as they voyaged came to an island inhabited by beautiful goddesses. Here the brother wished to remain, but, the husband protesting, they sailed on to the Yasawas, the most westerly isles of the group. Here was the cavern in which dwelt the

great bird, but it was empty, and they found only one little finger of the hapless Tutu Wathi Wathi. The angry gods now swore to avenge her death, when presently they saw the monster approaching, his great wings darkening the sea like the shadow of a storm cloud. In his beak he carried five large turtles and in his talons ten porpoises. These he deposited upon the rocks and proceeded to devour, while Okovo prayed the other gods to help him by sending a storm of wind. The prayer was answered, and a sudden gust ruffled the feathers of the monster, so that Rokoua was able to force a spear through an unprotected spot into his vitals. Having thus accomplished their just revenge, they took one of the smallest feathers for a new sail, and then cast the dead body into the sea, causing such a surge as to "flood the foundations of the sky."

It is to be regretted that these legends have not been more carefully collected by the earlier settlers in Fiji. Even the few of them which have been preserved exhibit a truly interesting national character. But this national character has been lost since the advent of the European. The Fijian of to-day does not like to be reminded in any way of the old days when cannibalism was in vogue. He is exceedingly sensitive to the sneer of the white man. While the race has been partially rescued from barbarism, it has lost its old vigor and spirit. The native population has of late years been decreasing at an alarming rate. An epidemic of measles, heedlessly introduced in 1875, carried off fifty thousand souls, about one third of the whole population of the islands. Fiji is but the vestige of a former continent, which has gone down beneath the steadily encroaching sea. The Fijians are fast becoming, before the resistless encroachments of the European, only the vestige of a former race.

We have here now a well-ordered British colony. Sugar, cotton, wool, tobacco, bananas, cocoanuts, and other agricultural products are exported in great quantities. The extensive plantations are worked largely by laborers introduced from India and the neighboring Pacific islands. But as a colony Fiji does not prosper. Better times are looked for when the Nicaragua Canal shall have become a reality, as these islands lie upon the great commercial route which will then be established between England and Australia.

ENUMERATING the applications that have been or may be made of zoölogy to the arts and industries, Dr. William A. Hardman showed, in the British Association, that biological principles dominate medicine and surgery; bacteriology and brewing depend on the study of microscopic organisms; economic entomology is of value in agriculture; and zoölogy has a practical application to the fishing industry.

MIRACLES IN FRENCH CANADA.

By EDWARD FARRER.

THE village of Beaupré, on the north shore of the St. Lawrence, twenty-one miles east of Quebec, is famous as the chief seat in America of the cult of Saint Anne, mother of the Virgin Mary. About 1620 a Breton crew, struck by a tempest off the lower end of the Isle of Orleans, vowed a sanctuary to her if she would rescue them, and on being driven ashore at Beaupré, then known as Petit Cap, built her a log chapel. A large wooden church was afterward put up, and in it Laval, first Bishop of New France, whose spiritual empire was so vast that it has since been divided into seventy dioceses, deposited a piece of a finger bone of Saint Anne.* In 1686 a stone church was erected and remains to this day. A much more splendid edifice was completed in 1889, at a cost of half a million dollars. In 1876 Pius IX "was pleased," writes one of the Redemptorist Fathers in charge, "to declare Saint Anne patroness of the Province of Quebec, without prejudice to the title of Saint Joseph, the patron of all Canada." The present Pope has bestowed honors and privileges upon the new church, which has received more relics of the saint, including a fragment of rock from her house in Jerusalem, "from the room, indeed, wherein took place the mysteries of the Immaculate Conception."

In the grandeur of its buildings and decorations, and in the elaborate machinery employed to fire devotion and attract pilgrims, the shrine is now second to none, except perhaps those of Lourdes and La Salette. A railroad has been built from Quebec, and steamboats make connection with the Intercolonial, Quebec Central, Grand Trunk, and Canadian Pacific. Huge boarding houses and hotels offer accommodation to visitors, who can also obtain rooms in the convent of the Gray Nuns. A miracle-working spring has been discovered, and the water is sold in bottles at a depository in the church. The Redemptorists issue a monthly

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* The Manual issued by the Redemptorists says Saint Anne was buried near Jerusalem, but her body was subsequently laid in the Church of the Sepulchre of Our Lady, in the Valley of Jehoshaphat. "One day a mysterious bark was seen to approach the shores of France. It had neither sail nor rudder, but God was its pilot. Never had the ocean borne a greater treasure. In this bark were Saint Lazarus with his two pious sisters, Saint Mary Magdalen and Saint Martha, together with several other saintly women. They were fleeing from Palestine with a number of priceless relics, the most precious among which was the hallowed body of Saint Anne. This treasure was placed in the hands of Saint Auspicius, the first Bishop of Apt." It was buried "to protect it from sacrilegious hands, and the place where it had been secreted was wholly forgotten" till, Charlemagne being at Apt one Easter day, "a miracle led to the discovery of the place."

publication to make known the cures. The bandages, sticks, and crutches piled in rows speak for themselves, as also the *ex voto* paintings, one or two by Lebrun, representing the saint in the act of delivering clients from perils by sea and land; American flags, bracelets, wax flowers, guns, knives, tobacco pouches, etc., are gifts from poorer clients who have experienced her kindness. Persons unable to visit the shrine, owing to bodily infirmity or any other restraining cause, may be represented by substitutes or may forward letters containing their requests to the saint; these are deposited beneath the statue in front of the main altar and prayers are said for a favorable answer through her intercession. The number of pilgrims exceeds one hundred thousand a year.

Nature has furnished an admirable setting for the shrine. The St. Lawrence at this point is four miles wide. Directly opposite Beaupré is the Isle of Orleans; behind it, the Saint Anne Mountain and the Laurentian Hills clad with pine, maple, and balm of Gilead. Cap Tourmente lies to the eastward; there the river begins to widen till at Tadousac, where the Saguenay joins it, it is thirty-five miles from shore to shore. To the west are the farmhouses and uplands of Château Richer, the Falls of Montmorency, from their bellowing and white foam called the *Vache*, Beauport and the valley of the St. Charles, Quebec and the historic rock. On summer evenings the old Breton hymn peals over the waters:

> "O sainte Anne, ô Mère chérie!
> Garde au cœur des Bretons la foi des anciens jours;
> Entends du haut du ciel le cri de la patrie—
> Catholique et Breton toujours!"

Even in winter, when the snow lies level with the fences and the St. Lawrence is gorged with ice, Beaupré attracts an occasional devotee. The height of the pilgrim season is from June to the middle of September.

Miracles are wrought for the most part in the new church, though the old one is still favored. Some find no immediate relief, but are cured on reaching home. At the ordinary services the officiating priest marches down from the high altar to some unhappy creature gasping at the rails, and, after a few preliminaries, applies one of the relics, incased in crystal with gold bands, to the part affected, reciting meanwhile the litany of Saint Anne: "Grandmother of our Saviour, Mother of Mary, Ark of Noah, Root of Jesse, Light of the Blind, Tongue of the Dumb." The other sufferers struggle to their feet and watch the process with breathless interest. The dying consumptive bares his breast that the relic may be placed directly over his lungs, then sinks to his knees at the foot of the statue; having finished the litany, the priest turns to the Gospel of Saint Anne; the thurifers surround

the patient and swing the incense, the relic is elevated, a bell rings, and the congregation kneels. This is the supreme moment. No time is lost, however, on a busy day, and when it is seen that a miracle is not forthcoming, the poor fellow is bundled into one of the sixteen lateral chapels, where other saints are venerated; his place is taken by another far-gone pilgrim, or perhaps a batch not so grievously afflicted are beckoned to the rails and the relic passed from lip to lip amid the prayers and sobs of five thousand onlookers. No one asks, with the skeptic in the temple of the sea-god, Where be the offerings of them that have perished? if only a single miracle be announced during the week or recorded in the monthly *Annales*.

The golden age of miracles in French Canada dates from the arrival of the Recollets and Jesuits, 1615–'25, and may be said to have terminated about 1860. The Church possesses many relics besides those of Saint Anne, some among the most precious in Christendom,* and has had local martyrs and confessors whose ashes repose here. Nevertheless, the stream of miracles outside Beaupré has gradually dwindled and dried up, and those of Beaupré are losing their old characteristics.

In the early days Saint Anne cured all manner of ailments with an untiring hand. The Relations des Jésuites for 1667 contain an account of the chief miracles wrought down to that time—the cure of Elie Godin of dropsy; Marguerite Bire, of fracture of the leg, Jean Adam, blind of both eyes; Pradere, a French soldier, of paralysis and *une apostume dans l'estomac*, and other wonders to which Laval bore witness. Saint Anne never raised the dead to life, at least not in Canada, nor gave a limb to a one-legged client as Saint Anthony of Padua did, but over and over again she cured heart disease, cancer, apoplexy, and consumption. She interfered to save pious persons from death in the forest, when they had been pinned under a falling tree, by inspiring neighbors to go to their aid or a faithful dog to carry a piece of blood-stained bark to the nearest settlement, and snatched many from ice jams, bush fires, and Dutch men-of-war, in the last case resorting to the

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* At the celebration in 1874 of the second centenary of the erection of the Diocese of Quebec over five hundred relics were exposed. The list is given in Le Deuxième Centenaire, an official account, bearing the *imprimatur* of Cardinal Taschereau. Among them were relics of the *vêtement de pourpre de Jésus Christ, crèche de Jésus Christ, colonne de la flagellation de Jésus Christ, sainte épine de Jésus Christ, table de la dernière scène, terre où Jésus pria, pierre sur laquelle Notre Seigneur s'assit et mangea avec ses apôtres, vraie croix de Jésus Christ*, etc. Also, apparel of the Virgin Mary and Saint Joseph, fragment of the rock struck by Moses, lock of hair of Saint Mary Magdalen, portion of the cloth of the head of Saint John the Baptist, fragment of a wooden altar served by Saint Peter, and of the block on which Saint Paul was beheaded, bones of the Holy Innocents, of the chief disciples, of Saint Stephen the first martyr, etc.

expedient of causing a fog to hide the vessel of her friends. She rendered barren women fruitful, and once or twice cured the dumb; by her efforts attempts to plant Jansenism in the colony were frustrated; she also brought to naught the designs of stray Huguenots. At the siege of Quebec Wolfe dispatched an expedition to harry the river parishes. "Wherever resistance was offered," says Parkman, "farmhouses and villages were laid in ashes, though churches were generally spared." The church at Beaupré was not spared by the troops; it was set on fire three times, but each time Saint Anne extinguished the flames, and some of the Highlanders confessed the miracle. When the north shore down to Cap Tourmente was blazing, nearly all the farmhouses in which she was specially venerated escaped.

But since 1860 or 1865, when the rush of population to the New England factories set in and French Canada began to receive at second hand the new ideas absorbed by the emigrants, the saint has been comparatively listless. She cures headache and dyspepsia, converts Protestants with Catholic wives, finds employment for clients, protects them while traveling, restores lost objects, procures young women admission to convents, and endows those who come to her in a proper spirit with grace and strength to quit evil practices. Now and then we hear of a hysterical girl being cured on the spot, or of an epileptic finding relief, but as a matter of fact the character of the miracles has deteriorated since faith in them has been shaken by New England influences. Hence the rather bitter remark, attributed to Mgr. Bégin, that if the French Canadians are supplanting the Puritan stock, Puritanism is having its revenge in French Canada.

Formerly images of Saint Anne were carried in procession through a parish to bring on rain or to stop rain, a ceremony that reminded one of the old Roman religion and the transportation of Bacchus, Ceres, and Dea Dia through the fields and vineyards by white-clad youths, followed by the lustral water and the full incense box. The practice is falling into desuetude; the *habitant*, like the rest of us, is beginning to be satisfied with the weather as it comes, and to have confidence in the predictions of the meteorological office. A bad crop is still attributed to the backsliding of the farmers or to the nonpayment of tithes. In French Canada the tithe, collectable by law and a first lien on the soil, is every twenty-sixth bushel of cereals. Of late, since the opening of the western prairies, the *habitants* have dropped cereal growing and taken to raising hay for the United States market. In this manner the *curés* have been cheated out of tithes, and some in whom the sense of reverence must have been dim pointed to the McKinley bill, which levied a duty of four dollars per ton, as an expression of the divine wrath.

The Normans and Bretons who colonized New France were governed to the end of their nails, as they used to say, from the mother country. The local self-government of the American colonies, the town meeting and its ramifications, were unknown; they were not allowed to hold meetings nor even to tax themselves for improvements without the royal permission. There were no common schools; the Recollets, or begging friars, taught the A B C as they wandered from parish to parish, but only where they found lodging for the night. As late as 1835 an act of the legislature was passed permitting school trustees to sign their reports with a mark. The *feu-follet*, or Will o' the wisp, was either an unshriven soul or Satan himself; *sorciers* were witches and imps who held their sabbaths on the Isle of Orleans; the *chasse-galerie*, a huntsman with a pack of dogs, appeared on the eve of a storm; but the most formidable apparition was the were-wolf, or *loup-garou*, which was seen as late as 1767 in the county of Kamouraska, seeking whom it might devour. None of these ugly visitors could cross a stream which bore a saint's name. If encountered in the woods, the *feu follet* could generally be dodged by sticking a needle in the earth or holding out a half-open knife after first making the sign of the cross; but the only safeguards against the others short of making a race for the St. Lawrence or the St. Something-else was for the traveler to carry a bottle of holy water, *Le Formulaire*, a prayer-book originally got up for the Ursuline nuns, or the *petit Albert*, which contained the forms for exorcising evil spirits.

The Jesuits have described the Arcadian simplicity of life and manners and the extraordinary piety of the early settlers, kept fervid both by their ministrations and by the constant Indian attacks. Every church had its own saint and relic, not necessarily of that particular saint, and its own miracles. Laval's successor presented the parish of Saint Paul in the Isle of Orleans with an arm bone of the great apostle of the Gentiles. A few years afterward the parish changed its name to Saint Laurent, and the adjoining parish of Saint Peter thereupon called itself Saint Peter and Saint Paul. The *curés* agreed to exchange relics, but the Saint Laurent people refused to be bound by that arrangement, and one night entered the church of Saint Pierre, carried off their old relic, and left the other, which they deemed an inferior one. Miracles beyond number were reported and passed into popular belief without being vouched for by ecclesiastical authority, such as missionaries using their cloaks as rafts to cross lakes and rivers, checking bush fires by drawing a line on the ground, being directed when they had lost their way and providentially supplied with food.

The Acadians had miracles in plenty. In the introduction

to A Legend of Montrose, Sir Walter Scott speaks of the portents which announced the Highland clearings—the notes of the night wind howling down the pass of Balachra modeled to the tune of We Return no More, the song with which Highlanders usually bade farewell to their native land; "the uncouth cries of the Southland shepherds and the barking of their dogs in the midst of the hills long before their actual arrival." I have been told at St. Pierre-Miquelon that the Acadians who fled to those French islands from the country of Evangeline were quite sure they had been forewarned of what was in store by the appearance of British armies in the sky, by dirgelike sounds from the ocean, and the wailing of souls in purgatory heard during Mass for a year before the calamity. In 1811–'12 Bishop Plessis visited Prince Edward Island, and in the account of his journey, published long afterward,* we are told that mysterious voices were heard in the Acadian churches, but not in the churches frequented by the Roman Catholics of Highland Scotch extraction. There was a groaning or sighing voice like that of a person in distress, and a singing voice like that of a woman or a child. On the mainland of New Brunswick these voices followed the Acadians to the lumber shanties, and were heard on Sundays when they gathered for prayer. In the churches the voices were loudest during the recitation of the litany of the Holy Name of Jesus. The good bishop asks: "What are these voices? Whence come they, and for what reason do they make themselves heard?" He comes to the philosophical conclusion that "as they have done no one any harm it matters little whether they cease or keep on." At the *grand dérangement*, as they call their deportation, the Acadians received at least one mark of favor from the Virgin Mary. Abbé Ferland tells the story in his La Gaspesie. Two hundred and fifty of them on board a vessel bound from Port Royal to the Carolinas overpowered the crew during a storm, fastened a scapular to the rudder, and invited the Virgin to take charge; she did so, and in a few hours they made land at Rivière Saint-Jean. The Virgin helped the French at the battle of Ticonderoga, appearing in white on the breastworks as the enemy came up for each fresh attack. She did not appear on the Plains of Abraham, nor during Montgomery's invasion; in the latter campaign, indeed, the mass of the French Canadians would probably have been glad if she had helped the *Bostonnais*.

There were legends among the French Canadians of revelations from heaven having been vouchsafed to the Indians. Mgr. de S. Valier traveled through the Gulf region in 1685–'87 in the capacity of *grand-vicaire* to Laval, and published a report at

* Le Foyer Canadien, 1865.

Paris in 1688, reprinted at Quebec in 1857. He speaks of the Cruciantaux Indians, who "have a particular respect for the cross," which they wore on their persons, planted over their graves, and attached to their canoes. An Indian "one hundred or one hundred and twenty years old" related that he had witnessed the arrival of the first ship that came from Europe to that part of the country. But the use of the cross among the Indians antedated that event and had not been introduced by outsiders. Once upon a time, during a famine, when the spirits had been appealed to in vain by the medicine men, an old savage saw in a dream a young man who promised the band an early deliverance by virtue of the cross, and showed him three crosses—one to protect them from visitations, another to serve them in their councils, the third to guard them in their journeys. When the old man woke he whittled three crosses just like them, and this is how the cult began. The incantations and *jongleries* of medicine men were sometimes blamed by the early white settlers for causing a failure of the crops. In these modern days the blasphemy of the *habitant* is blamed, though as a rule he seldom blasphemes except when plowing with fractious oxen. In a book (Une Mine, etc.) published in 1880 a worthy Oblat father asks, "Why these bush fires, droughts, wet seasons, frosts, hailstorms, worms, and flies that ruin your crops?" and goes on to ascribe them to the "torrent of bad language that deluges your fields."

When Father Labrosse, a famous Gulf missionary, died at Tadousac, the bells of all the churches were tolled by angels. The *crucifix outragé* is among the relics of the Hôtel-Dieu; it was used by a soldier in divinations by which he undertook to find lost money. A *fête* was established by way of public atonement, and miracles have since been performed with it. Here, as elsewhere, the corruption of names has given rise to legends of the miraculous and the uncanny. Thus Cap d'Espoir, Cape of Hope, has been twisted by English sailors into Cape Despair; the French have accepted the corruption and made it Cap Désespoir. Then to account for the name, tradition says one of the vessels of Sir Hovenden Walker's expedition against Quebec was cast away at the spot, and the remains of a wreck are still shown and known as the *naufrage anglais*. Till a few years ago the fishermen at Cap Désespoir used to be warned of storms by the apparition of this English frigate, with her terror-stricken officers and men gazing landward and the captain apparently upbraiding the pilot. The fishermen of the Gulf of St. Lawrence are as superstitious as fishermen elsewhere. They hear the lamentations of lost souls like the *braillard* off Rivière de la Madeleine and see supernatural lights like the *feu des Roussis* at Paspebiac. The haddock, *le poisson de Saint-Pierre*, was the first fish caught at the miracu-

lous draught in Lake Gennesaret, and the finger marks of the apostle are on its back. Nevertheless it is not a lucky fish, possibly because "their net brake" and they "filled both the ships so that they began to sink." The French-Canadian fisherman and the fisherman from old France work side by side on the Banks of Newfoundland. There is a marked difference in their accent and intonation as well as in their physical appearance, three hundred years of existence in the New World having made the French Canadian swarthier and leaner than the man from Saint Malo. On the rocks of Cap à l'Aigle at St. Pierre-Miquelon there is a white statue of the Virgin, and as his vessel passes it the French Canadian is careful to salute the "old mother," but the fisherman from France ignores her. While the latter sings modern songs from the *cafés* of Paris, the former sticks to the songs his ancestors brought from France—Malbrough, Dans les prisons de Nantes, Sur le pont d'Avignon, Par derrièr' chez ma tante, En roulant ma boule, etc. Both believe that a *sorcier* can find the best fishing ground on the Banks, that a dog on board brings good luck, that it is bad luck to whistle, and so on. At home the French-Canadian fisherman occasionally sees the Wandering Jew striding along the beach in the direction of Labrador, which, by the way, was the heritage of Cain. To meet him face to face brings good luck if you happen to be returning from vespers, but not otherwise. There is an old ballad about him in which, "near the town of Bruxell's in Brabant," he accompanies two honest fellows into a tavern and over a *pot de bière fraîche* describes the events at Jerusalem that led to his being banished "to everywhere and nowhere without end":

"Sur le mont du Calvaire
Jésus portait sa croix;
Il me dit, débonnaire,
Passant devant chez moi:
Veux-toi bien, mon ami,
Que je repose ici?"

But the Wandering Jew—Isaac Laquedemme by name, and by trade a shoemaker—was in bad humor that day, and replied *sans raison:*

"Ôtes-toi, criminelle,
De devant ma maison;
Avance et marche donc
Car tu me fais affront!"

Then came the terrible sentence:

"Jésus, la bonté même,
Me dit en soupirant:

'Tu marcheras toi-même
Pendant plus de mille ans;
Le dernier jugement
Finira ton tourment!'"

He has been tramping ever since, wearing his shoemaker's apron, and always with five sous, never more or less, in his pocket, glad to drink a glass of wine with any honest *bourgeois* he meets, but much tormented in soul when he halts for that purpose. The ballad, as sung in French Canada, is given in full in Ernest Gagnon's collection.

Among the miracles recorded by ecclesiastics, the most striking was the defeat of the English expedition against Quebec in 1690 by the Virgin Mary, to whom a church, still standing in Lower Town—Notre Dame des Victoires—was forthwith dedicated. Miraculous cures were wrought by the relics of the Jesuit Brebeuf, murdered in the country of the Hurons near Penetanguishene, and through invoking the Jesuit Le Jeune. These are about the only miracles officially credited to the Jesuits; they bear no comparison with those ascribed to the Jesuit Anchieta in Brazil; still less with those of St. Francis Xavier and the missionary thaumaturgists of his day. The performance of miracles by the Canadian Jesuits may possibly have been hindered by the presence of heretic traders from the neighboring English and Dutch colonies; it was cynically suggested at the time that unless they could banish the smallpox, always raging among the Indians and frequently attacking the settlements, it was useless to work minor wonders as a means of impressing either red men or white.

The nuns were more successful. Marie de l'Incarnation and the Mère de Saint-Augustin possessed the spiritual *charismata* of the Christian women of whom Tertullian wrote: "There is at this day among us a sister who has the gift of revelations, which she receives in church amid the solemnities of the Lord's day by ecstasy of the spirit; she converses with angels and sometimes also with the Lord, and she both hears and sees mysteries." The astounding visions of these two Quebec nuns are described at length by a recent biographer, Abbé Casgrain. Both were forewarned of the earthquake of 1663, when, as the Relations say, rivers and lakes changed their beds, mountains were swallowed, and forests hurled in the air, the trees falling on end with the roots upward; the warning was conveyed by the appearance of demons, which gathered over Quebec and were restrained for a time, but only for a time, by a majestic youth of whom they stood in awe. The statue of Notre Dame de Toute-Grâce, at the Hôtel-Dieu Convent, was wonderfully gifted. The Mère du Saint-Esprit, of that house, foretold its destruction by fire. In 1810 a Protestant woman visited it at Christmas and prayed

before the manger. She bore a child, which was the image of *l'Enfant Jésus*, and became a nun of extraordinary piety, on whom the Virgin lavished favors. Marguerite Bourgeois, founder of the Congregation of Our Lady at Montreal, is now undergoing the process of canonization; numerous miracles were worked by her before and after her death. Probably, in modern opinion, the most splendid miracle of all was the courage displayed by these well-born women in crossing the ocean and spending their lives amid the rigors of a semiarctic climate, Indian alarms, sieges, pestilence, and all the privations and hardships of a new colony for the glory of God.

When the Island of Montreal was wanted by the Sulpicians, a lay agent, apparently under Jesuit influence, had a vision in which the owner was guaranteed heaven without purgatory. The property, which has made the Sulpicians one of the richest orders in America, was immediately transferred. This, I believe, is the only instance of note in which the supernatural was invoked for a doubtful purpose. All the other visions and miracles can be accounted for without the hypothesis of conscious deceit. It was essentially a time when, as Dean Milman wrote of another age, "the Christian lived in a supernatural world; the notion of the divine power—the perpetual interference of the Deity, the agency of the countless invisible beings which hovered over mankind—was so strongly impressed upon the belief that every extraordinary and almost every ordinary incident became a miracle; . . . a mythic period was thus gradually formed in which reality melted into fable, and invention unconsciously trespassed on the province of history." This is kinder than Gibbon's verdict: "If the eyes of the spectators have sometimes been deceived by fraud, the understanding of the readers has much more frequently been insulted by fiction."

The seigniorial tenure, a mitigated feudalism based upon the Custom of Paris (1510), was abolished by the Canadian Parliament in 1854. It was then, a scoffing Parisian said, that the *habitant* of French Canada discovered that Louis XVI was dead. When he began to migrate to New England he learned other things that are slowly undermining his cradle beliefs, and we may say without a scoff that it will not be long till Good Saint Anne is dead.

REMARKING on some of the results achieved by the Challenger Expedition in the antarctic seas, Dr. Murray says that the amount of animal life found in the antarctic region south of 40° is very much more abundant than in any other part of the world. One of the great secrets of oceanic circulation may possibly be found by investigation of those regions. Certainly one of the greatest pieces of scientific and oceanographic work yet to be done on the surface of the globe awaits efforts in these regions.

HAS IMMIGRATION INCREASED POPULATION?

By SYDNEY G. FISHER.

THE immigration which formed the basis of our colonial population was very slight. The men who fought the Revolution and created the United States were almost exclusively native. The population of New England, as is well known, was produced out of an immigration of not much over 20,000, all of whom arrived before the year 1640. From 1640 until about 1820, a period of nearly two hundred years, the growth of New England was by the childbearing of the original and native stock. There was no immigration worth mentioning; but, on the contrary, an overflow into neighboring colonies, New York and the West. Franklin, writing in 1751, when the population of all the colonies was about a million, said that the immigration which had produced this number was generally believed to have been less than 80,000.*

Modern immigration set in some time in the beginning of the present century, and had grown to noticeable proportions about 1820, when the national Government decided to take statistics of it. By 1830 all observers agree that the foreigners had begun to have a decided influence and effect, and that a change could be distinctly seen. By 1840 the Native American or Know-Nothing movement had begun; in 1850 it had become a distinct political party; and in 1856 had a candidate for the presidency.

One of the strongest arguments used against the Know-Nothings was that immigration would greatly increase the population, and in that way the wealth and strength of the country. The rate of increase by births among the colonists had been remarkably rapid and had astonished the people of Europe. Franklin was among the first to call the attention of learned men to this phenomenon. In some parts of the country the people, without the aid of immigration, doubled themselves in twenty-five or twenty-seven years; and there were traditions of particular localities in which the doubling had taken place within less than twenty years. No record of a like increase over such an extended territory could be found in the history of the civilized world.

For the fifty years that followed the Revolution, when immigration was at a minimum, this natural increase was greater than ever. The whole population in that time doubled itself about every twenty-three years. It was therefore very natural for the people who believed in the immigration experiment to suppose that if to this increase in every decade were added a couple of million immigrants, who would presumably have children in the same

* Franklin's Works (Sparks's edition), vol. ii, p. 319.

rapid manner as the natives, the population, wealth, and strength of the United States would be forced forward in a manner that would produce results of inconceivable grandeur. It certainly did look like an enormous boom, irresistibly attractive both for its possibilities and for its uncertainties. The difficulty with it was that, like the rest of the experiment, it was all based upon "presume" and "suppose."

If the calculations had turned out as expected, we should undoubtedly now have a population of at least a hundred millions. Jefferson, writing in the year 1815, prophesied eighty millions for the year 1875, which would give considerably over a hundred millions for the year 1893. But, curiously enough, when the alien element had reached a certain point, about the year 1830, the native population began to fall off in births, and the more the aliens increased in numbers the fewer became the births of the natives. The foreigners themselves were not as prolific as the old native stock had been; and the consequence is that we have now to-day not as many people as we would have had if the immigrants had never come near us and the native stock had continued their old rate of increase.

The statistics which show this were very ably discussed many years ago by Mr. Edward Jarvis, and recently General Francis Walker has again called attention to them. The calculation is a simple one. We have the population at the close of each decade and also the number of foreigners in the country. Confining ourselves to the white population, if we subtract from the total whites at the close of a decade the number of foreigners at the close of the decade and find the difference between that result and the native whites at the end of the previous decade, we have the natural increase of the native population, and can easily find the percentage.

Let us therefore construct in this way a table which will show the growth of the native white population by decades from 1750 to 1890. Previous to 1750 the numbers by even decades are not obtainable. For the population previous to 1790 we shall take Bancroft's estimates, which are now generally accepted, and for the time after 1790 we shall rely on the revised figures of the national census. For the time previous to 1800 the number of foreign born living in the country has never been estimated, but they were very few and would not materially alter the results.

To find the number of natives it will be necessary to deduct from the total number of whites not only the European foreign born but also the people who came to us by a stroke of the pen when we acquired the Louisiana territory, Florida, Texas, New Mexico, and California. Louisiana was purchased in 1803, and her people considerably swelled the census of 1810. How much

they increased it is hard to say, for between 1803 and the time the census was taken in 1810 a large number of our people moved into the new territory, so that the population of the new territory for 1810 gives more than the number we ought to deduct. It is certain we ought to deduct something, and equally certain that we shall never know the exact amount. The best authorities, however, seem to indicate 20,000 as about the proper number. For Florida it is about 12,000, and for Texas, New Mexico, and California, which came to us by the Mexican War, it is about 90,000, to be deducted from the total whites as given by the census of 1850. We shall also have to make a deduction from the whites in the census of 1860, because part of the returns for California in the census of 1850 were burned, and the natives of that Commonwealth were not all given in the census of 1850, but appeared in the census of 1860. A deduction of about 70,000 will probably account for all of them.

Decades.	Total whites.	Foreign whites.	By new territory.	Per cent of native increase.	Corrections for census of 1870.	
1750.....	1,040,000					
1760.....	1,385,000			33·17		
1770.....	1,850,000			33·57		
1780.....	2,383,000			28·81		Revolution.
1790.....	3,177,257			33·33		
1800.....	4,306,446	44,282		34·14		
1810.....	5,862,073	96,725	20,000	34·79		
1820.....	7,862,166	176,825		33·76		
1830.....	10,537,378	315,830	12,000	32·83		
1840.....	14,195,805	859,202		30·64		
1850.....	19,553,068	2,244,602	90,000	29·10		
1860.....	26,922,537	4,138,697	70,000	31·91		
1870.....	33,589,377	5,507,229		23·37	25·37	Civil war.
1880.....	43,402,970	6,679,943		31·05	29·05	
1890.....	54,983,890	9,249,547		24·53		

The census of 1870 is now generally believed to have been an underestimate, owing principally to the difficulty of obtaining returns from the South so soon after the war. The rate of increase for that decade ought therefore to be a little more than 23·37, probably about 25·37; and this would lower the percentage of the next decade to about 29·05, instead of 31·05.

Following down the column of native increase, we find that from 1750 the rate remains at a little over 33 per cent for twenty years, until reduced by the Revolution to 28·81. But after the Revolution it returns again to 33·33 in the next decade, then rises to 34·14, and then to 34·79. In the next decade, 1810 to 1820, it falls suddenly about one per cent, and in the next falls one per cent again; and in the next, which is 1830 to 1840, falls more than two per cent to 30·64, which is much lower than it had been at any time in the previous eighty years, except during the decade

which contained the Revolution. The falling continues, with one or two slight revivals, as we follow the column, until in the decade 1880 to 1890 it has reached the very low figure of 24·53 per cent—more than four per cent lower than during the Revolution.

It is to be observed that the first serious fall begins after the year 1830, the point which all observers have fixed upon as the time when the effects of immigration began to be palpably felt.

If we look at the number of foreigners for the year 1830, we find them to have been 315,830—almost as many as there had been in the three previous decades. In the next decade they more than double, and in the next they almost treble, with the rate of native increase steadily declining.

It is also rather significant that the first break and decline of the native rate occurs after the year 1820, when immigration had begun to attract so much attention that the Government decided to take statistics of it.

These coincidences of the decline of the native increase with the increase of immigration are so exact that they can hardly have been accidental. There is, to say the least, a strong suspicion of cause and effect. And if it should be asked what is the exact nature of that relation of cause and effect, the question may be concisely answered in the words of General Francis Walker, superintendent of the tenth census and now President of the Massachusetts Institute of Technology:

"The access of foreigners, at the time and under the circumstances, constituted a shock to the principle of population among the native element. That principle is always acutely sensitive alike to sentimental and to economic conditions. And it is to be noted, in passing, that not only did the decline in the native element, as a whole, take place in singular correspondence with the excess of foreign arrivals, but it occurred chiefly in just those regions to which the newcomers most freely resorted."

That the arrival of the foreigners was a shock to the natives is very clearly shown in the formation of the Native American or Know-Nothing party, and the riots and violence which followed for a period of twenty years. The foreigners came to work for lower wages than the native and drove the native from his place. For a hundred years the native had been accustomed to a standard of living which was remarkably high. This was particularly true of the New England and Middle States, where all classes had every incentive in their surroundings to produce large families. They felt that they owned their country, and were proud of it. They were the creators of their own destinies and the architects of their own fortunes. They built up homes and families. They were sure there would always be enough for all, and that their children would have to enjoy as good, if not better, conditions.

"Then came the foreigner, making his way into the little village, bringing, small blame to him, not only a vastly lower standard of living, but too often an actual present incapacity even to understand the refinements of life and thought in the community in which he sought a home. Our people had to look upon houses that were mere shells for human habitations, the gate unhung, the shutters flapping or falling, green pools in the yard, babes and young children rolling about half naked or worse—neglected, dirty, unkempt. Was there not in this sentimental reason something strong enough to give a shock to the principle of population?"

The native of that time was utterly unable to compete in dirt and degradation with the low Irish and European peasantry. He lost heart and interest; in many cases he sank to the level of his competitor; and even when he did not actually sink in his personal habits, he had not the same high incentives as before.

It is a remarkable fact and should be remembered that in New England, which received scarcely any immigration between 1640 and 1820, the greatest growth of population ever known in America took place. The New-Englanders overflowed their borders, and settled a large part of western New York, the Western Reserve of Ohio, the Wyoming Valley of Pennsylvania, and hundreds of towns and counties in the far West. Some years ago the number of people of New England origin was estimated at a third of the whole population. The place of strongest nativism was the place of the most rapid growth.

Washington was much impressed in 1796 with the overflow of the New-Englanders. "Their numbers are not augmented by foreign emigrants; yet from their circumscribed limits, compact situation, and natural population, they are filling the western parts of the State of New York and the country on the Ohio with their own surplusage." (Works, vol. xii, p. 323.)

Madison was in favor of immigration, but in 1820 he could not help noticing the wonderful increase of New England without the aid of the foreigner. "It is worth remarking that New England, which has sent out such a continued swarm to other parts of the Union for a number of years, has continued at the same time, as the census shows, to increase in population, although it is well known that she has received but comparatively few immigrants from any quarter." (Works, vol. iii, p. 213.)

It has been suggested that the correspondence in time between the increase of immigration and the decrease of the rate of growth does not necessarily imply a relation of cause and effect, because it can be accounted for by the fact that advanced civilization always lessens the rate of childbearing and the rate of increase of popu-

lation. France is pointed out as an instance where the rate of growth has become very low because of the fashion the French have acquired, even in the middle classes, of restricting the size of their families.

The illustration, however, is not altogether fortunate for those who use it. The French annual rate of increase, it is true, sank very low during the four or five years previous to the Prussian War, being only seven per thousand inhabitants in 1870. But since then it has steadily risen, and in 1890 was thirty-seven per thousand.* In fact, France is an excellent illustration to show how mere ideas and opinions affect the growth of population, and how the rate of increase may be depressed by discontent or disaster, or raised by the desire to conquer an old enemy or by the success of a new form of government.

But is it true as a general proposition that advanced civilization decreases the rate of population? There is a feeling among many people, who have not thought much on the subject, that the more animal-like we become, the more we multiply, and that the lower types of civilization necessarily increase more rapidly than the higher. But this is very far from the truth.

Savages and uncivilized races are not, as a rule, of very rapid increase. They often recede and whole tribes of them become extinct. If we look at the whole world, it is the uncivilized populations that are disappearing. Before the coming of the English to the United States the red men had held the country with all its natural fertility and resources for hundreds of years, and yet had not been able to increase themselves to a million. During the middle ages, from the year 500 to 1500, a period of a thousand years, we find the population of Europe in all stages of barbarism and low civilization, and yet the increase of population was very slow. In the year 500 Europe was supposed to have something over 40,000,000 people. In the year 1500 the highest estimate is 70,000,000. Thus in a thousand years the population had not doubled. But after the year 1500, under the influence of the Reformation and modern civilization, the population doubled in three hundred years.†

Another excellent illustration to show the effect of modern civilization is the growth of the English people.

1480	3,700,000
1580	4,600,000
1680	5,532,000
1780	9,561,000
1880	35,004,000

* Mulhall's Dictionary of Statistics (1892), article Population, p. 442.

† Seaman's Progress of Nations (First Series), p. 550. See also Worcester's Problem of Religious Progress, *passim*, and Mulhall's Dictionary of Statistics.

The English, it will be observed, never succeeded in doubling themselves in any hundred years until 1780 to 1880, when they almost quadrupled.

Civilization, then, does not appear to be a very serious hindrance to rapidity of growth; and the reason is evident. As compared with barbarism, it produces a larger food supply, greater variety of it, better houses, better sanitary arrangements, better health, longer life, and stronger reasons for wanting to live and wanting to enable others to live. The people of the middle ages lacked skill in producing the comforts and necessaries of life, their sanitary arrangements were shocking and their lives despondent. They were visited with plagues and epidemics which have not now been known for four hundred years. Their minds were clouded with dreadful delusions, superstitions, and terrors which produced the "dance of death" and the continual slaughter of witches. A large proportion of their children died, and even adult life was short.

Long living and many who live long is as important an element in the increase of population as numerous births. All the children born in the United States in the year 1891, who die before they are eight years old, will not increase the population either in numbers or effective strength so much as one man born in that year who lives to be thirty. The man, independently of his greater usefulness, will be counted as an inhabitant in three censuses; the children will be counted in none.

Paupers, savages, and other people of low life are often supposed to multiply very fast because they seem to be so reckless in the number of children that are born to them. But the same shiftlessness which brings the children into the world surrounds them with conditions that destroy them. Negroes are supposed to be very prolific; but the death-rate among them in cities is almost double the death-rate among whites; and the death-rate among negro children is more than double the death-rate among white children. The woman of the slums, who was recently reported to have said that she ought to know something about the nurture of children because she had buried fourteen of her own, was doubtless a person of excellent intentions; but she has not done so well for the republic as some less boastful mother who has raised one son to maturity.

It is often thoughtlessly asserted that modern city life decreases population. But, as compared with ancient city life, it very much increases it. Previous to the year 1790, in all large cities, the death-rate always exceeded the birth-rate. In London the death-rate was often double the birth-rate. Immigration from the rural districts and not their own power of reproduction kept these cities from decay. Our modern cities contain certain dis-

tricts that are called slums. But the old cities were all slums. The great increase of modern city life is due not to the degeneracy of the race, as is often foolishly supposed, but to improved sanitary conditions and improved health. The modern city grows by its own productive force as well as by immigration and has ceased to be a death trap for the people.

Rapid increase of population is due to cleanliness, thrift, intelligence, prosperity, contentment, and happiness, because these things preserve and lengthen life. As a rule, civilized people are apt to be blessed in these particulars even when their birth-rate is somewhat low. But it is not true, as is often supposed, that the more civilized have necessarily a low birth-rate. Ireland and Greece are countries of an inferior order of civilization, and their birth-rates are respectively 27·7 and 24 per thousand inhabitants; while the birth-rate of England is 33·3 per thousand, and of Holland 34·8.

But we must not rest the question on mere generalizations. Civilization includes many things and is a broad term. Increase of population is accomplished by different causes, and not in every instance by the same cause. Each instance should be considered in all its surroundings before any general principles are applied. Mere sentiment, opinions, and ideas often affect the growth of population as much as the price of corn and meat. The failure of the French to increase rapidly is generally believed to be caused by an almost morbid desire on the part of French parents to start their sons in life with a fortune and give their daughters a dowry on their marriage. The size of these portions becomes a matter of pride, and great importance is attached to them even among the middle classes. The fewer the children the larger the portions. This condition is generally believed by modern French statesmen to have been brought about by the law of 1793 which restricted the freedom of leaving property by will and compelled parents to divide their estates evenly among their children. On the other hand, the English feeling is just the reverse of this. The Saxon race has always been remarkable for its love of facing life single-handed, and battling with the chances of the world. English parents of all classes have seldom any hesitation, and often a pride, in bringing up more children than their fortune will enable to live with ease. The thought that the eldest child will have all their money and the rest have to begin life anew, or that all will have to make their own way in the colonies, which would fill a French family with horror, is rather pleasant to English parents.

Any one who will read the history of the Know-Nothing movement in pamphlets, speeches, and deeds of that time can hardly fail to be convinced that hundreds of thousands of native Amer-

icans were rendered despondent, hopeless, and desperate by what they saw around them. Men do not fight in mobs and destroy churches and houses and form themselves into complicated secret orders for nothing. Whatever we may think of their mistakes of policy and rashness, there is no question that the native Americans received a severe shock, not only to their sentiments and feelings, but to their opinions and principles. The nation that they supposed was their own seemed to be given over to others. Their high patriotism, their pride and interest in their country were wounded and hurt. Nor was the wound any the less severe because the majority of those who received it were of the class in life that is not trained to express its feelings in writing.

What else was there in the general condition of affairs in the United States between the years 1830 and 1860 which would cause the rate of native growth to decrease? It could not possibly have been the growth of luxurious habits of living. There were none at that time. Any we possess have been acquired within the last twenty years, and most of them within the last ten years. The country at that period, so far as concerned room for development, was as new as it had been in 1750. Our people still lived in a fringe along the Atlantic seaboard. The buffaloes were ranging the prairies east of the Mississippi. The whole valley of that river was practically unsettled. The West was a great unknown. There was no crowding; and as for opportunities, they were greater than ever before. The arts of life and the comfort and health of living were all improving. Manufacturing industries were springing up. Commerce was increasing, new inventions were being perfected, occupations were becoming more numerous and varied, the people were happy, prosperous, jubilant in their successful nationality, and in 1830 railroads began. All things which enable population to increase were present, and population had been increasing rapidly until suddenly, coincident with the great increase in immigration, the rate fell, and has been falling ever since.

From that period down to the present hour all the facilities of business have improved, new occupations have been created, the medical and surgical sciences have improved, their improvement is more generally distributed, sanitary conditions are better, and as a consequence the average human life has been lengthened by two years.

After the civil war came to an end in 1865 the same condition existed. The West was still unsettled. The Union Pacific Railroad was not finished until 1869. The next ten years, with increasing facilities for reaching all parts of the country, gave the grandest opportunity for rapid growth that was ever known. Yet not only the rate of the native whites kept falling, but the rate of the

whole population, with the greatest immigration added, kept steadily falling.

What shall be said of the last decade, 1880–'90, when the increase of the whole population, with a still greater immigration added, has fallen to a rate which is four per cent lower than the rate of the native whites during the Revolution? Is this a crowded country? We have sixty-five millions in a territory which every one admits can easily support four hundred millions. Is this a luxurious, worn-out, jaded country? Where, how, and by what? Possibly among a fraction of the population in a few great cities. But they do not constitute the country. Look at the small towns, the great country districts, the masses of the people, and where are the signs of the luxury that enervates? Fashionable society has grown in recent years; but even admitting that it has grown to the fullest possible extent, and that it is guilty of all the folly with which it is charged, it has not yet become one fortieth part of the population.

Spain is said to be an old, worn-out nation, but during the ten years from 1880 to 1890 she increased the annual rate of her growth from 35 per thousand to 54 per thousand. Even France, though her rate had fallen very low in 1870, has steadily increased it in the last twenty years, and raised it from 7 per thousand inhabitants in 1870 to 37 per thousand in 1890. England has steadily increased her rate in the last twenty years. So has Russia, whose rate is very high, being 105 per thousand in 1870, 130 in 1880, and 140 in 1890. Holland, a very old and closely settled country, has increased her rate in almost the same proportions, 80 per thousand in 1870, 118 in 1880, and 135 in 1890. Belgium's rate is not far behind.*

Of all these countries none are superior to the United States in natural fertility and resources. Most of them are much inferior, and have a larger proportion of people to the square mile. The United States has only 21·31 to the square mile;† but Russia has 42, Spain 86, Great Britain 184, France 320, Holland 350, and Belgium 530.

If we are right in believing that the lowering of the rate of native growth was due to the increase of foreigners, then immigration has not materially increased, but, on the contrary, has somewhat decreased the American population. If the native population had kept up an increase per decade of only 34 per cent, which was less than it had in the twenty years 1790 to 1810, and immigration had ceased, the white population would

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* Mulhall's Dictionary of Statistics, article Population, p. 442.

† The average of 21·31 per square mile for the United States is calculated on the total land area, exclusive of Alaska and Indian Territory.

now be more numerous than it has become with the assistance of immigration.

If we take the native white population of 5,745,348 in the year 1810 and give it an increase each succeeding decade of 34 per cent, with 28 per cent for the decade that included the civil war, we have for the year 1890 57,048,753, which is 3,064,863 in excess of the 54,983,890 total whites as given by the census of that year. In other words, the natives multiplying at less than their old rate would outnumber the present native and foreign white population by over three millions.

The rate of 28 per cent for the decade that included the civil war is lower than the rate of native increase during the Revolution, and the Revolution lasted seven years, while the civil war lasted only four. The rate of 34 per cent for the other decades is also quite conservative. For twenty years, when immigration was at a minimum, the natives had exceeded this rate, and as their rate was steadily rising there is every probability that they would soon have exceeded 35 per cent, and reached 36 or more before 1890. An average rate of 35 per cent, with 28 for the civil war, would have given 60,098,117 whites in 1890, which is 5,114,227 in excess of the total whites as reported by the census, and lacks only about two millions of equaling the whole aggregate population of black, white, Chinese, Japanese, and civilized Indians.

The estimates of Jefferson and others by which they prophesied a great increase for the future were based on rates much higher than this. The country was new, with ample room for development, and growing more and more prosperous. European countries with dense populations and inferior natural resources have increased their rate within that time, and why should not the United States?

Some of these old countries increase their rate in spite of the fact that thousands of emigrants are leaving them every year. We have a new country, not half developed, with immigrants pouring into us, and yet our rate has been steadily falling for sixty years. Since 1830 the rate of increase of the whole aggregate population, black, white, Chinese, Japanese, and civilized Indians, together with all the immigrants that have been poured upon us and the accessions from the new territories, Louisiana, Florida, Texas, New Mexico, and California, has seldom been appreciably higher, and is in most cases considerably lower, than the old rate of increase of the native whites from 1750 to 1830, when immigration was at a minimum. All the immigrants and all their increase can not make up for the loss of the old rate of increase of the natives.

The following table shows that in only two decades, 1840 to 1850 and 1850 to 1860, was the rate of increase of the whole population higher than it had been among the natives alone before 1830. In

the first of those decades, 1840 to 1850, the rate was abnormal because the Mexican War brought us a sudden large accession of black and white population from the conquered provinces of Texas, New Mexico, and California. The rate in the second decade, 1850 to 1860, was also abnormal. The people who were not counted in California in the census of 1850, owing to the burning of part of the returns, were counted in 1860, and increased the rate for that decade:

	Aggregate population.	Per cent of increase.	Correction for census of 1870.
1830	12,866,020	33·55	
1840	17,069,453	32·67	
1850	23,191,876	35·86	
1860	31.443,321	35·57	
1870	38,558,371	22·62	24·62
1880	50,155,783	30·07	28·07
1890	62,622,250	24·85	

During the last twenty years immigration has reached enormous proportions. For the decade 1870 to 1880 the arrivals at ports, without counting those that came in over the Canadian and Mexican borders, were 2,834,040, and for 1880 to 1890 the same sort of arrivals were 5,246,613.* Added together they make for the twenty years 8,080,653, which is more than half of the total immigration since 1820. Yet with this enormous influx the rate of increase of the whole population has sunk lower and lower; and the twenty years which saw this huge immigration saw the lowest rate of increase since 1750.

From the year 1750 to 1830 the native population without the assistance of immigration never increased less than 33·17 per cent each decade except during the Revolution, when it went down to 28·81 per cent. But now, with a larger immigration than was ever known, the increase of our aggregate population is only 24·85—almost 4 per cent lower than the rate of increase of the native whites during the Revolution.

THE mopane tree of eastern Mashonaland, Africa, is described by W. A. Eckersley, of the railroad surveying party, as rarely attaining a height of more than twenty-five feet. "When first its leaves make their appearance they are bright red; this soon changes to a rich autumnal brown; passing through some further shades of that color, they finally assume a green of equal brilliance to the spring leaves of some of our English trees. Masses of these trees in the various stages of change form a remarkably picturesque effect; the strong contrast in which the brilliant reds and greens stand out against the background of the blue-gray granite is particularly striking."

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* Report of Superintendent of Immigration (1892), pp. 13, 30.

INSECTS' EGGS.

By M. V. BRANDICOURT.

JOHANNES SWAMMERDAM, a Dutch naturalist, who was the first to examine insects with a microscope, and whose investigations were published in 1757, gave some curious details concerning the eggs of insects.* "Some are oblong," he said, "others ovoid or round. There are also angular, pyramidal, striated, and granular eggs, etc. They are no less various as to colors, and we find them white, yellow, red, blue, green, and pied with different colors so singularly combined that it is almost impossible to describe them exactly. In consistence, some are soft, others hard; some membranous, others covered with a coat like parchment or with a real eggshell; some are covered with a kind of froth, others with hairs."

Swammerdam described with many details the eggs of the *Nepa cendrea*, a little fresh-water hemipter, which he called the water scorpion (Fig. 10). They are yellow and nearly of the same shape as the seed of the blessed thistle, slightly elongated, and rounded at the lower end. On the upper part they are provided with seven or eight slender branches, or hard threads, of which the point is red and the middle whitish. These appendages or threads, arranged in a circle around the circumference of the summit of each egg, form a kind of open egg cup, which receives the end of the next egg in its cavity. Thus these appendages of the first egg hold the lower end of the second, and so on.

The eggs of the *Lepidoptera* have considerable resemblance to the seeds of plants (Figs. 1, 2, 3, 4). "Those of the larger and smaller cabbage butterflies have the shape of a pyramid, of a height three or four times the diameter of the base, and the base is stuck to a leaf. The eggs are usually formed by eight rounded ribs, separated by flutings running from the summit to the larger end. On each of these sides may be seen an infinite number of flutings parallel to the base. The eggs of the great tortoise butterfly are nearly spherical, and are smaller in diameter at the base, or the part by which they are attached to the plant, than at the summit, whence eight equally distant crests descend along the body of the egg, forming ribs which diminish imperceptibly in height and disappear before reaching the end." †

These eggs resemble those of a night moth which attaches its

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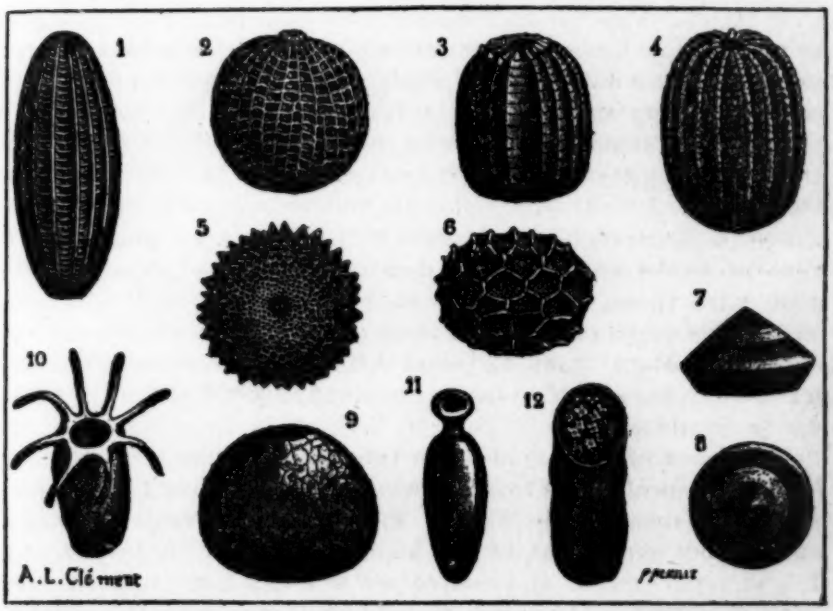
* *Histoire naturelle des Insectes* (Natural History of Insects). Translated from the *Biblia Naturæ* of Johannes Swammerdam. Paris, 1758.

† *Histoire naturelle des Insectes* (Natural History of Insects). By De Tigny. Paris, 1815.

eggs to the branches of trees. They hold there with such strength that they leave a scar on the bark, and even interfere with the nutrition of the branch. They are remarkable for being shaped like the stones that are cut for the construction of arches, and, "being larger at the summit than at the base, so that they join exactly, they arrange themselves in an arcade."

Some butterflies have eggs of very elegant shape, resembling a kind of little knob, fluted and girt with a small purple circular band.

The eggs of the dragon fly are elongated; at the upper end are a kind of flowerets like those of the louse nit. The gnat's



Figs. 1 and 2, eggs of the large and of the small cabbage Pieris; Fig. 3, egg of the Tristan butterfly (*Pupillo hyperantus*); Fig. 4, egg of the admiral (*Vanessa atalanta*); Figs. 5 and 6, eggs of Polyommatus; Figs. 7 and 8, eggs of *Dicranura vinula*, profile and front views; Fig. 9, egg of *Pygaera tricephala;* Fig. 10, egg of water scorpion (after Swammerdam); Fig. 11, egg of gnat; Fig. 12. nit of the louse (after Swammerdam, greatly magnified).

egg is like a skittle, the larger end of which is rounded, while the other end terminates in a short neck, like those of some liquor flasks (Fig. 11). The eggs of the ephemera can be observed only under the microscope, on black or blue paper. They are plano-convex and oblong. The membrane that envelops them has a nebulous appearance under the microscope. The eggs are white, like the inner coating of thin shell.

The *Euryanthus horribilis* of New Guinea, on the other hand, an orthopter of the singular tribe of the phasmids, which is twelve

or fifteen centimetres in length, lays eggs, it is said, as large as those of a humming bird.

The blowfly has an oblong, angular egg, with lozenge-shaped compartments forming a kind of network. They are very white and composed of two distinct envelopes, of which the outer one is a real shell like that of a hen's egg, and breaks as easily.

The egg of the ant is uniform, smooth, tight and bright, without any division. When the larva has come from it, only a very thin membrane is left, which rolls up and is reduced to an imperceptible point; and even if the egg does not hatch, it is still so small as to escape the eyes. This is why these eggs are so little known, for what is commonly and improperly called the egg is really the larva, and is endowed with life and motion. These eggs, or rather these larvæ, of ants are very much sought after by barnyard fowl. An old woman of Paris gained a very comfortable income by selling them at the Jardin d'Acclimatation to feed the pheasants. She collected them in the woods of the suburbs, indifferent to the bites she received from the old ants. Her trade extended from June till the end of September. Ants' eggs are considered a choice dish in some countries. They are spread upon a slice of bread and butter, and sauces considered excellent are made with them. They are esteemed as a costly food in Siam, within the reach only of well-to-do people. They are the object of an important trade in some countries of northern Europe, where they are cooked in boiling water, and yield a kind of vinegar or formic acid.

The eggs of certain aquatic insects resembling noctonectæ (*Corixo femorale* and *Corixo mannaria*, Geoffroy, and *Noctonecta Americana*) are eaten in Mexico. They are usually found deposited on the reeds and rushes of the lakes, especially of Lake Tezcuco. The egg-laden reeds and rushes are cut, dried, and beaten over cloths, to detach the myriads of eggs which are fastened on them. The eggs are very carefully cleansed, and are, after that operation, winnowed, put up in sacks like flour, and sold as material for cakes. This novel aliment, which is called *hantlé*, and is really water-flea bread, is the object of considerable trade in the markets of Mexico. It has a pronounced fishy flavor, and was used by the natives prior to the conquest. The eggs of another species (*Corixa esculenta*), which resemble manna, are eaten in Egypt, and form an element of very choice dishes.

The eggs of insects resist considerable variations of temperature. The most rigorous cold of our winters is fatal to the eggs only of the most delicate species; and the eggs can likewise resist the most intense tropical heats.—*Translated for the Popular Science Monthly from La Nature.*

SKETCH OF DAVID DALE OWEN.

DAVID DALE OWEN was born at Braxfield House, near New Lanark, Scotland, June 24, 1807. He was the fourth son and sixth child in a family of eight children. All but the first born, a son, lived to adult age. His father, Robert Owen, the celebrated philanthropist, was a native of North Wales.

Robert Owen, after working in the drapery business in London and elsewhere, entered into partnership with a mechanic, at eighteen years of age, in the manufacture of cotton-spinning machines. A year later he took a position as superintendent of a mill employing five hundred hands, and at twenty-two years of age he became a partner in an old-established spinning concern of Manchester. Having become attached to Miss Anne Caroline, the eldest daughter of David Dale, proprietor of large mills at New Lanark, near Glasgow, he arranged with his partners to buy the works of the father, and soon after obtained for himself the hand of the daughter. They were married in 1797. Undertaking the management of the works ("government" he called it), he steadily improved the condition of the factory hands, which had been there as elsewhere bad to a degree now almost incredible. Some of his measures were opposed by his partners, and led to several dissolutions of partnership through which he retained the management, but he was forced to retire in 1829 when fifty-eight years of age. In spite of what he spent for the workers, Owen always made the business pay well. For several years beginning with 1815, he worked for the passage of Acts of Parliament beneficial to factory operatives. Becoming convinced that social reform could be best secured through communism, he bought from the Harmony Society a tract of thirty thousand acres, and the buildings of their settlement at New Harmony, Ind. The Harmony Society was prosperous but wished to change its location. Coming to America in the spring of 1825, he organized a community of about nine hundred persons on a provisional plan. He returned to Scotland to look after his business, leaving his two oldest sons at New Harmony.

William Maclure, of Philadelphia, a man of means and devoted to philanthropy and the advancement of science, took part in founding the community. He heard of Owen's scheme on returning to the United States after an attempt to found an agricultural labor school in Spain, and believed that it would afford favorable conditions for carrying out his cherished idea of an educational institute founded on rational principles. He accordingly bought a large tract of land in New Harmony and vicinity, and removed thither his library and collection of minerals, which

were extensive, and his valuable scientific apparatus. He induced Gerard Troost, C. A. Lesueur, and Thomas Say, also Joseph Neef, the Pestalozzian, to come into the community with him, to act as instructors in the institution proposed. When the society was divided into a manufacturing and educational, and an agricultural branch, Maclure became the leading spirit in the educational division.

Owen visited New Harmony a second time in the winter of 1825–'26. His third visit was made in the spring of 1828, and by that time so many troubles had arisen that the community was disbanded. The failure of the undertaking was due to the one great cause that makes all communistic enterprises impracticable in the present age—the imperfections of human nature. In the same year Mr. Owen went to Mexico, on the invitation of the Government, to put his ideas into practice there, but effected nothing because the Government insisted that the state religion of the proposed community should be Roman Catholic. Some experiments were afterward tried by him in Great Britain, and he continued to advocate his views with voice and pen until his death, in 1858. His followers received the name of "Owenites." He published a considerable number of writings, including an autobiography.

David Dale Owen's early education, which was received from a private tutor, included the English branches, the rudiments of Latin, and a course in architectural drawing. He was also trained in the use of carpenter's tools in the mechanical department connected with his father's mills. He was for a time a pupil in the grammar school, or academy, at New Lanark. His father, while traveling on the continent of Europe, had visited the celebrated educational institution of Emanuel von Fellenberg, at Hofwyl, Switzerland, and was so much pleased with the system pursued in it—neither moral, physical, nor intellectual development being neglected—that he sent there first his two oldest sons—Robert Dale and William—for a three years' course, and after their return sent David and his younger brother Richard, in 1824, also for three years. The studies of the more advanced classes were partly elective, and David Dale and his brother chose chemistry, drawing, and modern languages in addition to the prescribed mathematical and literary course.

David Dale and Richard returned to Scotland in September, 1826, the former being then nineteen years old. They entered the classes in physics and chemistry conducted by Dr. Andrew Ure, author of the Dictionary of Arts, Manufactures, and Mines, at Glasgow, where their mother then resided. Their father was absent at New Harmony. For that place the two younger sons set out in November, 1827, going by a ship from Liverpool to New Orleans, thence up the Mississippi by steamer, reaching the settlement on the Wabash early in January, 1828.

During the next three years they kept up and increased their knowledge of chemistry by repeating the experiments of Dr. Ure's course. Desiring to extend his knowledge of chemistry and geology, David Dale Owen in 1831 returned to Great Britain. He had as a companion Henry D. Rogers, and they both lived at the house of Owen's father in London while attending the lectures of Dr. Turner at the London University.

After about a year abroad Owen came back to the United States. Soon after his return he was stricken with Asiatic cholera, which was epidemic in this country in the summer and fall of 1832, but was fortunate enough to survive the attack. Wishing to increase his knowledge of anatomy and physiology as an aid in the study of paleontology, he entered the Ohio Medical College, in Cincinnati, and was graduated in the spring of 1836. He devoted the summer following his graduation to gaining practical experience in field geology. To this end he accompanied at his own expense Dr. Gerard Troost, who was then engaged on the State Survey of Tennessee.

Dr. Owen married, March 23, 1837, Caroline C. Neef, the third daughter of that pioneer of Pestalozzian education in America, Joseph Neef.

Dr. Owen had been appointed State Geologist of Indiana and immediately after his marriage he entered upon the duties of this position. He made a preliminary reconnoissance in 1837 and 1838, his report upon which was published immediately after its completion and reissued in 1859. Geological science being little understood in the West when this document first appeared, a brief introductory exposition of the leading formations was given in it, after which the rich deposits of coal, iron, and building stones within the limits of the State were described.

The Hon. James Whitcomb, then Governor of Indiana, was soon afterward appointed Commissioner of the General Land Office, and Congress having ordered a survey of the Dubuque and Mineral Point districts under the direction of his bureau, he selected Dr. Owen, with whose ability he was well acquainted, to conduct this examination. These districts comprised eleven thousand square miles of the Northwest Territory, now included in the States of Wisconsin and Iowa, and the object of the examination was to enable the commissioner to reserve from sale those sections found to contain mineral wealth. But a short time was allowed for the work, hence it became necessary to organize a large force. The difficulties involved in such a rapid prosecution of the survey are indicated in the report presented by Dr. Owen to the commissioner, April 2, 1840. "In one month from the day I received my commission and instructions," he says, "(to wit, on September 17th), I had reached the mouth of Rock River; engaged one hun-

dred and thirty-nine subagents and assistants; instructed my subagents in such elementary principles of geology as were necessary to the performance of the duties required of them; supplied them with simple mineralogical tests, with the application of which they were made acquainted; organized twenty-four working corps, furnished each with skeleton maps of the townships assigned to them for examination, and placed the whole at the points where their labors commenced, all along the line of the western half of the territory to be examined. Thence the expedition proceeded northward, each corps required, on the average, to overrun and examine thirty quarter sections daily, and to report to myself on fixed days at regularly appointed stations: to receive which reports and to examine the country in person, I crossed the district under examination, in an oblique direction, eleven times in the course of the survey."

It was in the spring of 1840 that William Maclure died. As administrator of his estate, his brother Alexander engaged Dr. Owen to assort the very extensive collection of minerals and fossils which Mr. Maclure had made in the course of his geological exploration of the United States and his travels in this country, Europe, and the West Indies. Specific suites were to be distributed to certain schools and colleges, and the remainder was to be retained by Dr. Owen as the nucleus of a museum. These directions were duly carried out. With regard to the portion remaining in Dr. Owen's hands The American Geologist* states: "To this latter Dr. Owen subsequently added largely, by purchase from Dr. Krantz, of Germany, illustrative fossils of every period; among others an ichthyosaurus, from the Lias of Würtemberg, larger than the one in the British Museum. Another interesting and valuable specimen was a nearly complete skeleton of a gigantic megatheroid animal (the Megalonyx) which he exhumed near Henderson, Ky. The entire collection some years after Dr. Owen's death was purchased by the Indiana University, and unfortunately nearly all consumed by fire, when the new university building, including the museum, laboratory, and library, was destroyed."

Dr. Owen was again called into the service of the Government in 1847, being appointed United States Geologist and directed to make a survey of the Chippewa land district. His Preliminary Report, made in the following year to the Hon. R. M. Young, then Commissioner of the Land Office, was a document of one hundred and thirty-four octavo pages, and was accompanied by three hundred and twenty-three lithographs from his own sketches, and numerous maps, diagrams, etc.

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* Sketch of the Life of David Dale Owen, M. D., August, 1889, to which source acknowledgment is due for the greater portion of the material entering into the present article.

The scope of his examination was then enlarged so as to embrace a fuller survey of portions of the Northwest Territory, lying mainly within the present States of Wisconsin, Iowa, and Minnesota. This task required five years of field work and a final year of laboratory and office work, ending with the year 1852. A large appropriation was made by Congress for illustrating and printing Owen's report, all the details of publication being committed to him. The result was a finely illustrated quarto volume of six hundred and thirty-eight pages, many of the illustrations being from the original drawings of Dr. Owen, who had great facility in sketching. In this volume he applied for the first time the medal-ruling style of engraving to cuts of fossils.

In an article on Geological Surveys in Missouri Mr. Arthur Winslow says of Owen's reports up to this time: "These reports supplied the guiding lines along which later stratigraphic work in the Mississippi Valley was done. Without attempting here to present the history of this work, its bearing upon the future work in Missouri calls for brief mention. In the Indiana reports Owen makes a separation of the rocks, in harmony with the English classification, into—1. Bituminous coal formations. 2. Mountain limestone. 3. Grauwacke. 4. Crystalline and inferior stratified rocks. In the succeeding reports, as the results of wider observation and more thorough study, the classification was changed and differentiated until, in the final report, we find a classification which, not only in its general features, but in many of its details, is still adhered to in Missouri."

From 1854 to 1859 Dr. Owen was occupied with the geological survey of Kentucky, having been appointed State Geologist by Governor Powell. The results of his explorations were published as the work progressed, and compose four large octavo volumes. Dr. Robert Peter, of Lexington, Ky., performed the chemical work of the survey and made a special report upon it.

Toward the close of his labors in Kentucky, in October, 1857, Dr. Owen was commissioned to conduct a geological survey of the State of Arkansas. His principal assistant in the Kentucky survey, Mr. E. T. Cox, filled the same position in the new work. The chemical assistant on the latter survey was Dr. Elderhorst, author of a work on the blowpipe. Various incidents in his several surveys prove Dr. Owen to have been a man of indomitable perseverance. Once, while on the Red River of the North with a Canadian *voyageur*, the fowling-piece used by the latter for procuring game was discharged in such a way as to lodge a number of shot in Dr. Owen's shoulder. But he did not permit the accident to delay him an hour. Again, the summer occupied with the field work of the Arkansas survey, a considerable part of which was necessarily spent in the rich and malarious bottom lands,

proved very detrimental to his health, bringing him home in the autumn with a hue denoting serious derangement of the liver. Yet he not only persevered in his explorations, but occupied himself in winter with laboratory work, usually until midnight. He did not desist even when suffering acutely from his last illness, but dictated the closing portions of his report until within forty-eight hours of his death. Between Dr. Owen and Governor Conway, who had given him the Arkansas appointment, there always existed the most cordial good feeling, and the latter provided every facility for the prosecution of the survey. Toward the end of 1860 postal communication between the North and South was considerably interrupted, for the breach which culminated in civil war was already opening. Yet the Governor, at considerable pains, succeeded in sending safely to New Harmony several thousand dollars due from the appropriation, and required for the publication of the second volume of the report. Dr. Owen had died, and the issuing of this volume, for which he had left full instructions, fell to his brother and administrator, Prof. Richard Owen. The latter also executed a second survey of Indiana, for which his brother had been appointed in 1859, with the understanding that Richard should do as much of the work as might be necessary.

The labors above outlined resulted in undermining the originally good constitution with which David Dale Owen had been endowed. Malarial fever, complicated with rheumatic attacks which threatened the heart, terminated his career of usefulness November 13, 1860. He left a widow, two sons, and two daughters. Dr. Owen's character was marked by integrity and amiable simplicity; his kindness and liberality were well known, and his scientific work was always conscientiously performed. His fondness for chemistry led him to build at a cost of ten thousand dollars a laboratory fully equipped, which served as a material evidence of his good taste in architecture. His architectural taste was further evinced in the artistic design which he submitted for the Smithsonian Institution building. He also tested many varieties of building stone before the selection of material for that structure was determined.

His artistic skill enabled him, besides richly illustrating his reports, as above noted, to leave good portraits in oil of members of his family. He transmitted to London views of the fossil *Sigillaria* found erect *in situ* twelve miles from New Harmony, with a description, which were presented to the British Association for the Advancement of Science by Sir Roderick Murchison. He subsequently conducted Sir Charles Lyell to the locality while the latter was his guest at New Harmony in his second visit to the United States.

PROFESSIONAL INSTITUTIONS.

VIII.—TEACHER.

By HERBERT SPENCER.

TEACHING implies knowledge of things to be taught; and as, for various reasons, the priest comes to be distinguished by his possession of knowledge, from him more especially is it to be obtained. Moreover, being released from life-sustaining activities, he has more time than others for giving information and enforcing discipline.

A deeper reason for this primitive identity of priest and teacher may be recognized. Though during early years each youth gathers, in miscellaneous ways, much which is properly to be called knowledge, and which serves him for guidance in ordinary life, yet there is a kind of knowledge, or supposed knowledge, particularly precious, which does not come to him through the irregular channels of daily experience. Equally in savage tribes and among early civilized peoples, ghosts and gods are believed to be everywhere, and always influencing men's lives for good or evil; and hence of chief importance is information concerning the ways in which conduct may be so regulated as to obtain their favors and avoid their vengeance. Evidently the man who knows most about these supernatural beings, the priest, is the man from whom this information of highest value is to be obtained. It results that the primitive conception of the teacher is the conception of one who gives instruction in sacred matters.

Of course the knowledge thus communicated is first of all communicated by the elder priests to the younger, or rather by the actual priests to those who are to become priests. In many cases, and for a long time, this is the sole teaching. Only in the course of evolution along with the rise of a secular cultured class, does the teacher as we now conceive him come into existence.

Necessarily in early stages of all evolving aggregates the lines of organization are indefinite. In groups of the uncivilized we can not expect the function of educator to have become distinctly marked off. Still we soon detect that inculcation of secret and sacred things which, as above indicated, constitutes the earliest kind of teaching: the "mystery men" being the instructors. Says Bernau concerning the Arawaks:—

> "The son of a conjurer, as soon as he enters his twentieth year, or even sooner, is made acquainted by his father with the art of conjuration, and enjoined the greatest secrecy concerning it."

And whether the neophyte be a descendant or not, there is always this injunction of silence respecting the communicated informa-

tion, which invariably has reference to dealings with supernatural beings; so that, from the very first, there is shown the rise of an esoteric cult such as the priesthoods of early historic peoples show us.

But in groups of savages we may trace an extension of this sacred teaching, or rather part of it, to all young men on their arrival at the fit age. The Australians, for example, have everywhere an initiation ceremony during which the youth, circumcised after a fashion, or in other cases having a tooth knocked out, is thereby dedicated to a supernatural being supposed to be present, as in the case of Daramūlŭn, who is doubtless the hero of the tribe: the dedications being obviously akin in spirit to those of more civilized peoples. On these occasions the medicine-men are the operators and instructors.

The more advanced of the uncivilized, whose medicine-men have gained in some measure the character of priests, furnish better evidence. We have the case of the New Zealanders, among whom, according to Thomson, one of the duties of the priests is to instruct children in the songs and traditions of the people—to instruct them, that is, in the sacred lore of the tribe. Then in Africa, where the social organization is more developed, we meet with a more definite form of priestly tuition. Bastian tells us that in Congo the fetich-priest yearly collects the boys who have arrived at puberty, and leads them into the forest, where they remain six months, forming a sort of colony under the control of the priest. During this time they undergo circumcision. Then in Abyssinia and in Madagascar we find the teaching function of the priest shared in by a non-priestly class—a step in differentiation.

Peoples, past and present, in sundry parts of the world, who have reached higher stages of civilization, yield fragments of evidence which I string together in as orderly a way as is practicable. Writing of the Mexicans, Torquemada says that the whole education was in connection with the temples. Very many boys were sent there to be educated from the fourth year of their age until their marriage. Clavigero tells us the same thing. Of the priests of Yucatan we read:—

"They instructed the sons of other priests, and also the younger sons of the lords, who were given to them from childhood when they appeared to be inclined to that office. The sciences which they taught were the computation of years, months, and days, festivals and ceremonies, the administration of their sacraments, etc., etc."

Of existing peoples the Japanese may be first named as supplying us with a relevant fact.

"The secular teacher's vocation can scarcely be said to have existed prior to the days of the founder of the Tokugawa dynasty. . . . The bonzes

[priests] of Japan are to be credited with being mainly instrumental in spreading a knowledge of the rudiments of education throughout the length and breadth of the Empire."

In his *Embassy to Ava* Syme writes:—

"All kioums or monasteries are seminaries, in which boys are taught their letters and instructed in moral and religious duties."

To like effect, from a work entitled *The Burman*, by Shway Yeo, we learn that—

"When a boy has reached the age of eight or nine years he goes as a matter of course to the Pohngyee Kyoung [Monastic School]. It is open to all alike—to the poor fisherman's son as well as to the scion of princely blood."

And the Catholic missionary Sangermano testifies similarly: implying, also, that this education given by the priests is nominally in preparation for the priesthood, since the students all put on "the habit of a Talapoin" during the period of their education. The Mahometans, too, yield evidence. At the present time in Cairo the university is in a mosque.

Illustrative facts taken from the accounts of extinct and decayed civilizations in the Old World, may be next grouped together—some of them mere hints and others sufficiently full.

Concerning ancient India, Dutt states that education consisted of learning the Vedas, and that in the later as in the earlier periods it was under the priests. He also says:—

"There were Parishads or Brâhmanic settlements for the cultivation of learning . . . and young men went to these Parishads to acquire learning."

To this there must be added the significant fact that in the Epic Period (*ca.* B. C. 1400 to 1000)—

"Besides these Parishads, individual teachers established what would be called private schools in Europe, and often collected round themselves students from various parts of the country. . . . Learned Brâhmans who had retired to forests in their old age often collected such students round them, and much of the boldest speculations in the Epic Period has proceeded from these sylvan and retired seats of sanctity and learning."

Taken in conjunction with the preceding statements this last statement shows us how teaching was in the beginning exclusively concerned with religious doctrines and rites, and how there eventually began to arise a teaching which, in some measure detached from the religious institutions, at the same time entered upon other subjects than the religious.

A kindred, if less elaborated, system existed in ancient Persia.

"It is pretty clear that the special training of boys for future callings went hand in hand with their religious education, and that it was chiefly regulated according to the profession of the father. . . . It was evidently also no uncommon practice to commit children to the care of a priest for training and instruction in the same manner as the Indian Brahmins were wont to do."

Respecting Babylonia and Assyria Professor Sayce, describing the social life there, says:—

"The libraries were established in the temples, and the schools in which the work of education was carried on were doubtless attached to them."

"The 'house of males' into which the young men were introduced, seems to have been a sort of monastic establishment attached to the great temples of Babylonia."

Of educational arrangements in Egypt the like is said by various authorities—Brugsch, Erman, and Duncker.

"Schools were established in the principal towns of the country; and human and divine wisdom was taught in the assemblages of the holy servants of the gods."

"The high priest of Amon, Bekenkhonsu, tells us, that from his fifth to his seventeenth year he was 'chief of the royal stable of instruction,' and thence entered the temple of Amon as an under-priest."

"The colleges at these temples [Thebes, Memphis, and Heliopolis] were the most important centers of priestly life and doctrine."

That absence of a priestly hierarchy in Greece which, as before pointed out, interfered with the normal developments of other professions, interfered also with the normal development of the tutorial profession. The temples and their surroundings were indeed places for special culture of one or other kind, mostly having some relation to religious observances. But this form of priestly teaching did not grow into any general system taking in the lay members of the community. Referring, by contrast, to education in the *gymnasia*, Mahaffy writes:—

"The older fashion had been to bring up boys very much as we bring up girls, keeping them constantly under the eye of a special attendant or teacher . . . teaching them the received religion and a little of the standard literature, inculcating obedience to the gods and to parents."

As happened in Persia during its phase of militant activity, physical culture and culture of the mental powers useful in war took precedence of other culture.

"The old system of advanced education, which ordained that from the age of eighteen to twenty Athenian youths . . . should remain under State supervision, and do the duty of patrols round the outlying parts and frontier forts of Attica, receiving at the same time drill in military exercises, as well as some gymnastic and literary training," became in time modified to one in which "most of the gymnastics and military training was left out."

But intellectual culture as it increased fell into the hands not of the priests but of secular teachers. "Those philosophers who did not, like the Stoics, despise teaching youths, . . . set up their schools close beside these gymnasia."

Still more in Rome, where the course of evolution was so much modified by the intrusion of foreign elements and influences, was the normal genesis of the teacher interfered with. Always when militancy is extremely predominant, mental acquisition, regarded

with no respect, is not provided for: instance the fact that in Japan, "during many centuries previous to Iyéyasŭ's time, the very numerous warrior-class like the Knights of Mediæval Europe, despised a knowledge of letters as beneath the dignity of a soldier, and worthy only of the bard and priest." And it was thus in Rome.

"The economic arrangements of the Romans placed the work of elementary instruction in the mother-tongue—like every other work held in little estimation, and performed for hire—chiefly in the hands of slaves, freedmen, or foreigners, or in other words chiefly in the hands of Greeks or half-Greeks."

This condition of things will be comprehended when we remember firstly that the normal genesis of teachers from priests is due to the fact that in early stages priests are distinguished by their superior knowledge; secondly that the priests in Rome were not thus distinguished, since the subjugated Greeks were more learned than they; and thirdly that all attributes of conquered men are liable to fall into contempt.

On passing northward to the peoples of pre-Christian days and to those of early Christian days, we are again shown the primitive identity of priest and teacher and the eventual separation of the two. Elsewhere saying of the Celts that their training, wholly military, aimed to produce endurance, agility, and other bodily capacities, Pelloutier writes:—

"Pour entretenir les peuples dans la dépendance, et pour être toujours consultez comme des Oracles, les Ecclésiastiques vouloient être les seuls Savans: et de l'autre, les Celtes, qui regardoient tout travail, tant du corps que de l'esprit (Procop. Gotth. L. I., cap. 2, p. 311) comme une chose servile, abandonnoient de bon cœur toutes les Sciences à leurs Druides, qu'ils consideroient non seulement comme des Savans, mais encore comme de véritables Magiciens. Les études des Nations Celtiques se réduisoient donc uniquement à apprendre par cœur certains Hymnes qui renfermoient leurs Loix, leur Religion, leur Histoire, et en général tout ce qu'on vouloit bien que le peuple sût." (To keep the people dependent upon them, and in order that they might always be consulted as oracles, the Ecclesiastics wished to be the only men of knowledge; and, on the other hand, the Celts, who regarded all labor, whether of body or mind (Procop. Gotth. L. I., chap. 2, p. 311), as servile, readily left all the sciences to their Druids, whom they held to be real magicians as well as men of knowledge. The studies of the Celtic nations were therefore reduced simply to learning by heart certain hymns in which were embodied their law, their religion, their history, and, in general, all that it was desirable the people should know.)

And congruous with this is the statement of Pliny concerning the British:—The druids "taught their pupils, and harangued to them concerning their doctrines; they made public speeches to the people, and instructed them in morality."

Almost extinguished during early centuries of our era, such

culture as survived was to be found only in ecclesiastical institutions, and out of them grew up afresh. As Hallam says:—

"The praise of having originally established schools belongs to some bishops and abbots of the sixth century. They came in place of the Imperial schools overthrown by the barbarians. . . . The cathedral and conventual schools, created or restored by Charlemagne, became the means of preserving that small portion of learning which continued to exist."

Mosheim, describing the Church of the sixth century, further tells us that in the cathedral schools the clerical teacher "instructed the youth in the seven liberal arts, as a preparation for the study of the sacred books;" and that in the monasteries "the abbot or some one of the monks instructed the children and youth that were devoted to a monastic life." These last facts verify the statement, made at the outset, that primarily instruction, whether given to lay or clerical youth, concerned itself directly or indirectly with religious propitiation: the avowed purpose, as expressed by the Council of Vaison, being to make the young "attach themselves to holy books and to know the law of God."

Subsequent centuries of wars and social derangements witnessed a decay of these ecclesiastical teaching institutions, notwithstanding efforts from time to time made by popes and bishops to reinvigorate them. But, as was to be expected, when there began to arise lay teachers, there arose clerical resistance. Then, as always, the priestly class disliked to see the instruction of the young falling into other hands. In France, for example, the Chancellor of Ste. Geneviève, who granted licenses to teach at the Paris University, used his power sometimes to exclude able men, sometimes to extort money, and had repeatedly to be restrained by papal injunctions. So, too, was it in Germany.

"All the professorial posts in the Universities were in the hands of the clergy, until the end of the fifteenth, and even into the sixteenth, century."

In Heidelberg, 1482, "a layman was for the first time, after a severe struggle, allowed to become a professor of medicine."

"The general admission of lay professors to clerical offices did not take place until 1553."

Our own country presents like evidences. In old English days "parish churches were often used as schools," says Pearson. And, according to Sharon Turner,—

"The clergy were the preceptors of those who sought to learn . . . to them the moral and intellectual education of the age was intrusted. . . . Thus the Irish monk Maildurf, who settled at Malmesbury . . . took scholars to earn subsistence."

So it was, too, in subsequent days. We read in the same two authors that after the Conquest—

"The numerous clergy scattered up and down through England had a

direct interest in promoting education. They eked out their scanty stipends as tutors and schoolmasters."

"One of the first fruits of the revival of literature in England, was the universal establishment of schools. To every cathedral, and almost to every monastery, a school was appended. . . . Few persons of any note appear to us among the clergy, during the century after the conquest, who did not during some part of their lives occupy themselves in instructing others."

In exemplification may be named, as distinguished teachers belonging to the priesthood during the Anglo-Saxon period, Bede, Alcuin, Scotus Erigena, and Dunstan. And after the Conquest, as teachers sufficiently conspicuous to be specified, come Athelard of Bath, John of Salisbury, Alexander Neckam, Roger of Hoveden, Duns Scotus.

But here as elsewhere the secularization of teaching slowly went on in sundry ways. Early in the fifteenth century laymen here and there left money for the founding of schools. Warton, writing of the early part of the sixteenth century, says:—"The practice of educating our youth in the monasteries growing into disuse, near twenty new grammar schools were established within this period." At the same time there was initiated a slow change in the character of our universities. Beginning as clusters of theological students gathered round clerical teachers of wide reputation, they, while growing, long continued to be places for clerical education only, and afterward simulated it. Almost down to the present day acceptance of the legally-established creed has been in them a condition to the reception of students and the conferring of distinctions; and they have all along preserved a teaching and discipline conspicuously priestly. We have residence in colleges under a *régime* suggestive of the monastic; we have daily attendance at prayers, also monastic in its associations; and we have the wearing of a semi-priestly dress. But gradually the clerical character of the education has been modified by the introduction of more and more non-religious subjects of instruction, and by the relaxation of tests which a dominant ecclesiasticism once imposed. So that now the greater part of those who "go to college," do so without any intention of entering the Church: university teaching has been in a large measure secularized.

Meanwhile the multiplied minor teaching institutions of all grades, though they have in the majority of cases passed into the hands of laymen, still, in considerable measure, and especially throughout their higher grades, retain a clerical character. The public schools in general are governed by ecclesiastics; and most of the masters are, if not in orders, preparing to take orders. Moreover, a large proportion of the private schools throughout the kingdom to which the wealthier classes send their sons, are

carried on by clergymen; and clergymen in multitudinous cases take private pupils. Thus the differentiation of the teaching class from the priestly class is even now incomplete.

As significantly bearing on the evolution of the teacher, let us further note that at the present moment there is going on a struggle to reacquire that clerical control which a secularized system of public education had in chief measure thrown off. Even when established a quarter of a century ago, this public education was not completely secularized, since certain biblical lessons were given; and now a strenuous endeavor is being made to add to these biblical lessons certain dogmas of the Christian creed established by law, and so to make the teachers of Board Schools to a certain extent clerical teachers. Nor is this all. Clerics have striven and are still striving, to make the public help them to teach Church dogmas in Church Schools. At the present time (June, 1895), the Primate and clergy at large are fathering an Act which shall give them State-funds without State-control. With an arrogance common to Priesthoods in all times and places, no matter what the creed they say to the State—"We will say what shall be taught and you shall pay for it."

No more here than elsewhere do we meet with an exception to the segregation and consolidation which accompany differentiation; though, partly because of the more recent separation of the teaching class from the clerical class, this change has not been so conspicuous.

The tendency towards integration of the teaching class, and marking off of them from other classes, was first shown among theological teachers. At the University of Paris—

"half-learned persons, who had scarcely any knowledge of the elements of theology, took upon themselves the office of public teachers. The consequence was, that the theological teachers of better reputation united themselves, and formed a regular society; and they had sufficient influence to establish the rule, that no one should be allowed to teach without their approbation and permission. This of course led to an examination of the candidates, and to a public trial of their ability, and to a formal ceremony for their admission to the dignity of teachers or *doctors*."

In our own universities the like has happened. Knowledge, first of established Christian doctrine, and then of other things held proper for teachers of Christian doctrine to know, and then examinations testing acquisition of such kinds of knowledge, have served to create a mass of those qualified, and to exclude those not qualified: so forming a coherent and limited aggregate. Though dissenting sects have insisted less on qualifications, yet among them, too, have arisen institutions facilitating the needful culture and giving the needful clerical authorizations.

Only of late have secular teachers tended to unite. Beyond

the various training colleges which instruct and examine and authorize, there are now sundry professional associations. Of a general kind come the Teachers' Guild and the Scottish Educational Institute. Then of more special kinds come the Head Masters [of Public Schools] Conference; the Association of Head Masters of Intermediate Secondary Schools; the Association of Head Mistresses; the College of Preceptors; the Association of Assistant Masters; the National Union of Teachers.

So, too, with the appliances for maintaining a general organization of all concerned in education—schoolmasters, assistants, colleges, and the various unions above named. This professorial class, like other professorial classes, has journals weekly and monthly, some general and some special, representing its interests, serving for communication among its members, and helping to consolidate it.

WHY THE SEA IS SALT.

By G. W. LITTLEHALES.

FROM the first chapter of the first book of Moses, called Genesis, we learn that, as between water and land, the ocean had the first place in terrestrial existence, for it is there stated that on the third day in the calendar of the creation the waters under the heavens were gathered together and the dry land appeared. Both from a chemical and a geological standpoint it appears that the waters of the ocean were salt from the beginning. Dr. T. S. Hunt, one of the ablest writers on the physical history of the globe, in his chemical and geological essays, referring to that period when the earth was in a molten state and surrounded by an envelope of gases and of vapor of water, states: "There would be the conversion of all the carbonates, chlorides, and sulphates into silicates, and the separation of carbon, chlorine, and sulphur in the form of acid gases which, with nitrogen, vapor of water, and a probable excess of oxygen, could form the dense primeval atmosphere. The resulting fused mass would contain all the bases as silicates, and must have resembled certain furnace slags or volcanic glasses. The atmosphere, charged with acid gases which surrounded this primitive rock, must have been of great density. Under the pressure of a high barometric column condensation could take place at a temperature much above the present boiling point of water, and the depressed portions of the half-cooled crust would be flooded with a highly heated solution of hydrochloric and sulphuric acids, whose action in decomposing the silicates can easily be understood. The formation of the chlorides and sulphates of the various bases, and the separation of

silica, would go on until the affinities of the acids were satisfied, and there would be a separation of silica taking the form of quartz, and the production of sea-water holding in solution, besides the chlorides and the sulphates of sodium, calcium, and magnesium, salts of ammonium and other metallic bases. The atmosphere, being thus deprived of its volatile chlorine and sulphur compounds, would gradually approximate to that of our own time, but would differ in the greater amount of carbonic-acid gas."

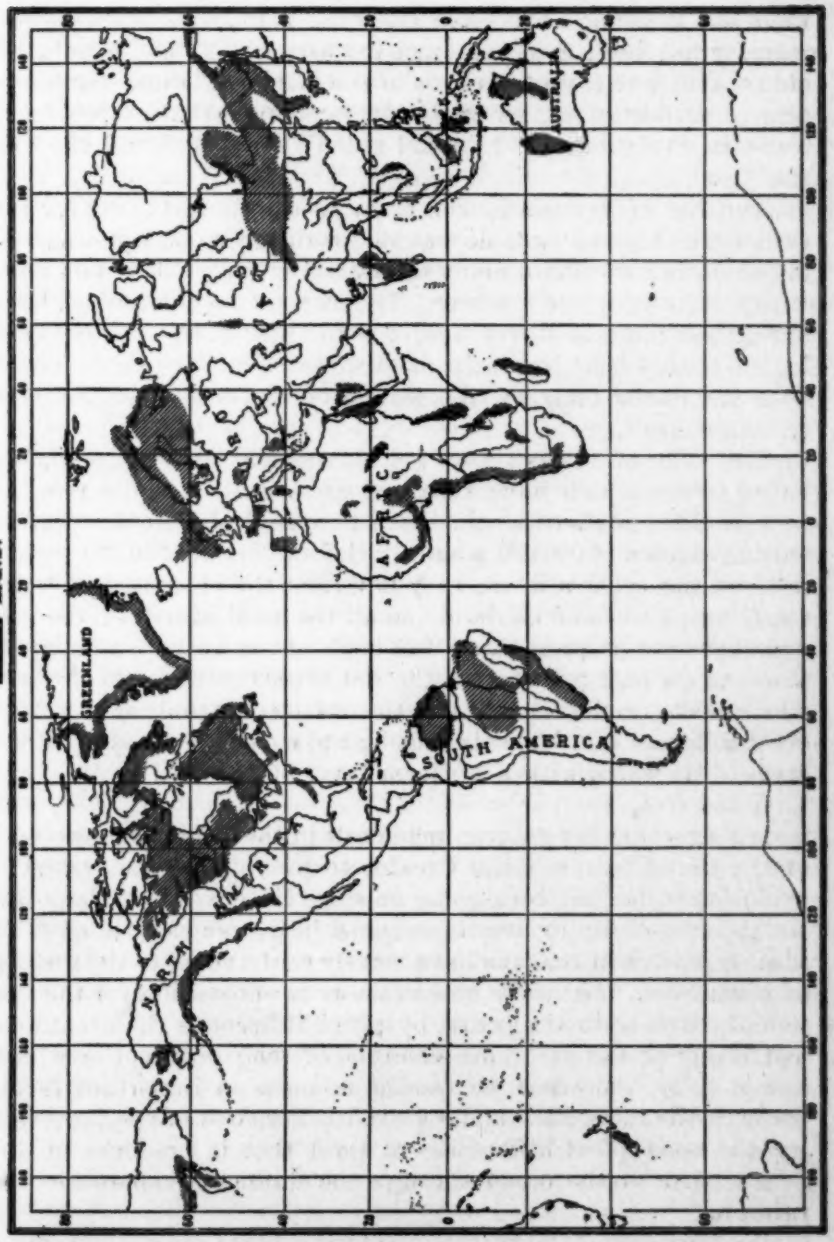
And the meteorologist Abbe, in the course of remarks made before the Philosophical Society of Washington in 1889, expressing the propriety of wholly rejecting the idea that the earth was once a molten globe, stated: "The study of geological climate during and since the formation of Azoic metamorphic strata has led me to adopt the conclusion that surface geology, like volcanic, does not demand excessive temperatures; it seems to me most reasonable to assume that the surface was never much warmer than 250° F., but to allow that this temperature may have prevailed at the close of the Archaic epoch.

"At this temperature all the water of the ocean would exist only as vapor and clouds in the atmosphere. The steady, hot rain from the atmosphere would rapidly disintegrate the surface rocks. Small seas and lakes of water saturated with alkalies and *salts* would at once begin to form the rocks that we know as metamorphic and archæan. The covering thus formed would contribute to diminish the rate of cooling of the interior mass, thus allowing the atmosphere to cool down to its present condition and deposit the most of its moisture."

In the rocks formed earliest after Archæan time, to which geological age only crystalline rocks devoid of fossils belong, there are found aquatic relics of organisms with calcareous skeletons which when living bore a close generic relation to organic forms which are confined to oceanic waters at the present time. Among these early inhabitants of the sea were corals, crinoids, sea urchins, and starfishes, and many others there doubtless were which, although they require the saline constituents of the sea to live upon, had no calcareous skeletons, and consequently have not been preserved in a fossil state. The remains are found deposited in the lower Silurian as well as the Devonian, Carboniferous, Jurassic, and Cretaceous formations.

But apart from these deductions concerning the saltness of the primeval ocean there is direct evidence that the waters of the sea in the early part of Paleozoic time were highly saline, for there were deposited from the waters of the Silurian sea saliferous strata which constitute the Onondaga salt group and the Trenton and Chazy limestone series, in which the relics of marine organ-

isms largely abound, to prove that they result from the sediment deposited by the ocean in that age.



Throughout all geological time the sea has also received salt from the continents, for the rain, falling upon the land, filters through the layers of saliferous soil and, springing to the surface

through some natural duct, finds its way to the sea with its burden of salt. But when the waters of the ocean are evaporated to form clouds and rain, the salt is left behind, so that ever more and more salt is being transferred from the land; and this ceaseless transfer has been going on since the first brooks and rills gathered together to form the rivers of the primeval lands. This process of salinification, which is identical with that which takes place in every lake and inland sea, like Great Salt Lake and the Dead Sea, into which streams flow but from which none emerge, has often been looked upon as a sufficient cause for the existing saltness of oceanic waters, for the ocean occupies a great closed basin into which many thousands of rivers flow, but from which none take their source. It must not be overlooked, however, that there is direct evidence to show that in early geological ages, when the continents were small and before the rivers were numerous or large, the waters of the vast ocean of those times were salt.

The salts of the sea have fed, throughout all time, countless living things which have thronged its water and whose remains now form the rocks of continents or lie spread in beds of unknown thickness over 66,000,000 square miles of the 143,000,000 square miles of the ocean's floor; they have lent the substance to build the fringing reefs of the land and all the coral islands of the sea, and there are at present, on the basis of an average salinity of three and a half per cent, in the 290,700,000 cubic miles of water which make up the oceans, 90,000,000,000,000,000 tons, or 10,173,000 cubic miles, of salt. This is sufficient to cover the areas of all the lands of the earth with a uniform layer of salt to a depth of one thousand feet.

It seems that the sea was made salt in the beginning as a part of the grand design of the Creator to provide for the system of evolution which has been going on since the creation. Many distinct species of living organisms exist in the sea as a result of its salinity, and their remains have largely contributed to the growth of continents. The three great factors in accounting for the system of currents in the ocean, by which it becomes the great heat distributer of the globe, are changes of temperature, the winds, and salinity. The last mentioned becomes an important factor through the immediate and essential differences of specific gravity and consequent differences of level that it produces in different parts of the ocean through the action of evaporation and rainfall.

If, through the fall of rain upon a portion of the ocean or through the action of evaporation in the surrounding parts, the waters of that portion become lighter than the rest down to a certain distance below the surface, two different kinds of motion will imme-

diately occur. The lighter water will be lifted by the surrounding heavier waters till there is no difference in pressure between its lower boundary and the surrounding waters at the same depth; but, as its pressure at all levels above this lower boundary will now have become greater than that of the surrounding heavier waters, it will instantly begin to displace and overflow them. This movement of the lighter water will require considerably more time than the movement of the heavier water by which it was lifted and continues to be lifted as its level sinks by lateral diffusion, because the sum of the differences of pressure which caused the lifting of the lighter water was, in the first place, greater than the sum of the differences that caused its lateral diffusion. Secondly, the differences of pressure that caused the first movement must extend all the way to the bottom, whereas those which cause the latter extend no deeper than the lighter stratum itself, and, even within the extent of that, have their chief effect confined to the superficial strata.

On the other hand, when the equilibrium of a mass of water is disturbed by causes that do not diminish the specific gravity, the disturbance must extend down to the bottom, and the differences of pressure at all levels beneath the surface must be equal. The equilibrium is then restored by a general movement of the whole mass, which movement is sensible in inverse proportion to the mass that is set in motion. This is the essential cause for the difference in strength between the currents observed in salt and fresh waters, for, of all the current-producing causes which act in fresh waters, only the one resulting from variations of temperature can sensibly affect the specific gravity, while the specific gravity of sea water, besides being much more affected by variation of temperature, is still further influenced by the fresh water which rains upon the surface of the ocean. If the whole basin of the ocean were filled with fresh water and exposed to the most extreme meteorological influences, the currents produced would not be nearly equal either in size or strength to those now observed in the waters of the ocean.

So the saltness of the sea is involved in all the great subjects into which the ocean currents enter. Having contributed to the growth of the continents, it has in a like degree peopled them by influencing human migrations through the streams of the ocean upon which the race of man was spread to the distant archipelagoes at a time when there were only rudimentary means for struggling against the forces of Nature. Besides its influences in geology and anthropology, it is concerned to a marked extent in the climate of the earth and of the sea, and in their botany and zoölogy.

A NATURAL PAPER MILL.

By VIRGIL G. EATON.

DIGGING out here in my back pasture lot, so I may find water for my cows when next summer's drought comes on, I have discovered one of the oldest paper mills in the world—a mill that was in good working order when Alexander went east for other nations to subdue, and one which had whole quires and reams in stock when men lived in caves and the human families exchanged calls with the monkeys. The land here is drift clay, which, mixed with sand and duly baked, makes fine building brick, and which raises such fine timothy hay that the new tariff does not bother me a mite. It is blue clay clear down for twenty feet, when it strikes an old sea brush of dark gravel plentifully filled in with clam, quahog, and scallop shells. Below this are coarser gravel and bowlders, and then comes the ledge, a heat-scorched, flinty clay slate that is almost crystallized in many places. For several miles the land is as level as a house floor, and here the rainfall hesitates so long about choosing a direction in which to run that the larger part stays where it falls until the warm sun licks it up to form more clouds to make more rain. Then such portions of the land as are not covered with sward or some form of vegetation crack open, and the millions of innocent tadpoles perish from thirst before they know what fun it is to wear legs and breathe atmosphere. Draining this land is out of the question, because in order to do it I should have to dig a ditch four miles across my neighbor's property before the water could escape; and while this might be a very praiseworthy act, it would most surely take all the money I have, and my fellow-farmers would reap the reward equally with myself. Wells are also impossible here, because the frost throws out the walls in two years; and as cattle can not drink out of an artesian-well pipe, I am digging a small pond to hold the rainfall.

The place I have selected is a gentle depression in the generally level land. It is about ten rods in diameter and is walled around by a natural clay embankment varying in height from two to five feet. An opening in the wall lets the water in from one side, while a miniature cañon allows it to escape in the opposite direction. Rushes, flags, and sedges stand knee deep in the waters close to the shore, and a few lilies, with leaves like arrowheads, dot the pool, which is otherwise given over to frogs, newts, and aquatic insects. Into the bowels of this wizard's caldron I am digging and scraping in hopes I may keep enough of the surface water in store so that the suns of August shall not leave my pasture dry. Working here, daubed with the muck and the clay

from which the race is made, I have found the aged paper mill about which I started to tell.

This particular paper mill—for there are dozens of them on my land and thousands of them on the tract—is in the bed of the rill which feeds the reservoir I am making. The rivulet soaks down across the pasture at a cripple's gait, going out of its way to extemporize shallow ponds here and there, and finally, after swelling up a little to surmount the ring of clay wall, topples over into the pool, which, from its size and conformation, I think is a scar or dent that still remains from some stranded iceberg that grounded here millenniums ago, and dissolving, left the hole in my field which I am trying to enlarge. The land is very dry at present, and looking in the bed of the extinct feeding mill I see it is carpeted with a grayish-brown matting that has a sheen like gossamer silk, and which crackles like stiff paper when struck with my spade. It stretches up the channel for rods and follows the windings very closely. I tear off some from the dead grass stalks, and when I hold it up to the light I find it is very good paper, thin, fairly strong, and in places semitransparent. Under this coat is another, and still another, so when I put my spade down the full length of its blade I find I can not reach through it all. A hand glass shows it is full of zigzag and irregular ribs, like the wings of a fly. These are the coarser portions of the paper, but the whole fabric is made of the same material, which is simply the shredded and digested woody fiber of the coarse grasses and rushes growing by the brookside. For centuries past these have flourished in the summer time until killed by the frost. The snow came, beating down the dead herbage, and before spring the whole was bedded in ice. Gradually the rill gnawed its way through the ice cap and the water began to sweep past the dead grass, now lying horizontally in the current. Slowly, atom by atom, the pith, gum, starch, and silex in the grasses were washed away, leaving only a fine and complexly mingled meshing of woody fiber where once were rushes, foul meadow, and blue joint. Then the brooklet receded before the warmer rays of a gaining sun, and a green scum, composed of infusoria and numberless low-grade microscopic plants, formed above the slackened water, filling all the spaces in the pulp network already in place. This settled with the water until stopped by the stumps of the broken grass, and then for a few weeks the stream ran under the canopy until it dried up altogether, and spiders hunted their prey concealed by a shade of natural paper. Again the grasses came up and grew and died. The snow of the next winter, which beat them down, pressed the underlying paper flat into the bed of the brook, and again the paper mill was making ready for a new output. Year by year this went on, no

matter who was President or what London bankers charged for exchange. Shredded by ice and frost all winter, washed from impurities during the spring, and dried in sunlight in the early summer, the paper was completed and ready to store away when the grasses were high enough to shade the ground.

Thus the work went on all the year and all years until the present large supply is on hand. Before now I have been told, and indeed I have read in cyclopædias, that the wasps were the earliest paper makers, and that wasp nests were the first paper the world ever saw. This is evidently an erroneous idea. Grasses and rushes came on this planet long before wasps or bees, and coarse grasses with water and sunlight have perhaps been in partnership in the paper business since long before the coal age in America. Out here on my farm I can trace the history of this mill back to a time long before Adam walked in his garden, and I have every reason to believe there were other and similar mills in operation eons or cycles previous to the time mine began its work.

It is an interesting study to take up this latest issue of the great serial record and glance over the events which it noted right here during last summer. Of course a full story of the field's doings is not told, but I find enough to keep me busy and cause me to search for more. The tale is not twisted or distorted by reporters' imagination in order to make it read well, neither is it marred by typographical errors, causing the reader to guess at what was the writer's intention. The matrix was good and the impression was perfect all over the sheet. Writers of the realistic school, like Zola and Howells, can take lessons from this author, for here are the remains of the conflicts and tragedies narrated pressed flat upon the paper and terribly in evidence to vouch for every detail. Modern newspapers, with all their boasted push and enterprise, can never hope to equal this aged annual which dates its first number back to two thousand years before Methuselah began to grow whiskers.

Records of the whole season are found on this paper, telling the story of what has been going on in the animal world as plainly as if it were printed with life photographs and for sale on the street. Here are a half dozen "wiggler boats" that once served as skins for mosquito larvæ. When the wigglers grew large and were ready to quit the waters these cases cracked open along the back, and out stepped the mosquitoes, armed and equipped to prey upon the summer visitors. Near by are two legs and portions of the wing cases of a big locust. It is hard to tell whether he died a natural death or perished from violence. On looking at the fragments more closely, however, faint threads may be seen here and there, showing that he succumbed to some

artful spider. The web proper is gone, the spider can not be found, but there is the story all told inside of half an inch's space. Farther on are the feathers of a bird, evidently a sparrow, which were probably torn out by a ravenous hawk. Yes, here is a spatter of blood on the paper that the rains have failed to erase and will never wash out, though that paper is buried for years. Across the middle of the sheet is where an earthworm has traveled, and near at hand is the track of a mole, its mortal enemy. The mole followed the worm, and the footprints mar the straight channel made by the annelid all the way. A broad wavy line in one corner shows where a snake has been along, seeking for stray bugs, and over all the slimy tracks of the slow but industrious snails shine like mica. In addition to these, I find the fragments of a cabbage butterfly's wing with the powder still clinging in places; a few hairs of a muskrat, loosened, perhaps, by a predatory mink; several dead dragonflies, as stiff as mummies; the head of a dead ant, with his big eyes staring at me as if in reproach; the cases of two caddice worms; and bits of severed twigs and grass and leaves and bark innumerable. I have found all these sitting here and looking at the paper I have torn up and which has not surface enough to cover the top of my desk; but the tale it tells is the history of the whole summer with its loves and hates and mirth and music—simply the story of one summer printed in pictures on paper, and issued by Nature to file away in her great library of past events.

Below the top pages are the other books of this valuable collection. Every sheet represents a year. Possibly, in seasons where two dry spells with an intervening period of continued rainfall occur, there may be two sheets of paper issued in a year; but then, again, there have been very wet years when no paper at all could be made, so it is safe to count on one sheet a year. Taking this as the basis of my calculations, I dig out a bit of the record on the point of my spade about midway to the bottom and count up how many sheets I cut through in going down an inch. The sheets are very fine and closely pressed, so I find trouble in counting, but after several trials I feel sure the average is fully three hundred sheets to an inch, which would make thirty-six hundred sheets to every foot in depth. Now, my spade blade is a foot long, and below this is as much more, and that takes me away back of any historical record now extant. So here I have a paper factory that is more than seven thousand years old, and the same blue clay and sand and shells were under it then that are there now. Yet my paper mill was started in modern times when the glacier works were on the surrounding hills no plainer than they are to-day.

Beyond doubt this little handful of crumbling, grass-im-

bedded, peaty pulp I now hold in my hand was made and filed away at a time when the mastodon came along here for food and the big American elephant shook the earth with his heavy steps. If I had time and patience, what a story this old library of primitive paper could tell me! It would be the tale of the world, who lived on it, how they lived and how they died, the story of storm and freshet and tornado, of drought and fire and famine, and the family record of every insect, mammal, and bird which has visited this field for the past seven thousand years. The proofs of the photographer fade and go out to nothing, the images of the spectroscope die with the light which created them, and the dormant words in the phonograph lisp and stutter with age and much using; but Nature's record book, which is always open and always getting new additions, holds fast to every fact, no matter how trivial it may seem, and will keep them all there in evidence until the senile earth wrinkles up, like a sun-dried lemon, and floats through space a cold and shriveled husk. This paper mill, I have found, old as it is, measures but one beat of the pendulum on the great clock of geologic time, a clock that was wound up millions of years before man came on earth, and will continue to run for millions of years after the last human being has gone.

A heavy rainfall came on before I had finished my digging, and when I visit my paper mill again it is flooded with water. Both work and study are useless here at present, and I pass an hour watching the pool, and noting how the added water has increased the activity of the aquatic animals that make it their home. All the wigglers in wigglerdom are out zigzagging themselves to the top of the water to stick their star-shaped noses up for a bit of air, and then falling to the bottom again to feed on the decaying muck. The pond seems alive with them, and the frogs are having a feast, eating wigglers by the dozen at every swallow. My ducks come waddling up from the house, and enter the pond for a swim; but, catching sight of the frogs, they conclude to abandon their bath and have a frog dinner. For the next ten minutes the water is a splashing, boiling sea, lashed into waves by fleeing frogs and pursuing ducks.

THE report of the British Association's Committee on the Teaching of Science in Elementary Schools represents that while much improvement has been made in the character of the teaching, difficulty still exists in getting it done by experiments and in a truly educational way, rather than as a series of useful but isolated facts. School teachers are generally enthusiastic in their endeavor to obtain a knowledge of science when classes are organized for their benefit. Progress is making in the number of subjects taught in elementary schools and the number of pupils receiving instruction.

Correspondence.

THE VALUE OF VEGETABLE FOODS.

Editor Popular Science Monthly:

SIR: I have just read Dr. Benjafield's lecture, in the September number, on Fruit as a Food and Medicine. I have read the Popular Science Monthly for twenty-five years, or rather from the very first number, and have always found it filled with very valuable and intensely interesting matter; but the above article I consider, from a hygienic standpoint, rather superior to anything I have read anywhere for a long time.

I am well aware of the great value of fruits as food and medicine. I prefer a ripe Baldwin apple to any other fruit grown or sold in this country. A deep-red Baldwin is the finest. Its color indicates that it is grown in the sunlight, which makes it chemically superior to one grown in the shade, which is more apt to be of green color. As the doctor says, *lemon juice* is of great value. My spring medicine for many years has been the juice of one lemon in as much, or a little more, water—no sugar—taken every morning for a week or ten days. I usually take it fifteen or twenty minutes before breakfast. It corrects biliary tendencies, and acts as a fine tonic and appetizer.

I have found apples to have a fine tonic effect on the stomach; one good apple will usually give me a fine appetite in ten minutes. I usually eat two or three good-sized apples at every meal; they constitute a *large part of the meal*, not an embellishment at the end of it.

I have found, since using apples largely, that the physical power of endurance under labor, either mental or physical, is very much increased; also a gain in flesh. This I attribute largely to the fact that apples assist the digestion and assimilation of food of other kinds. Chemists record that apples contain a larger percentage of nitrates and phosphates (food for brain and muscle) than any other fruit.

Care should be taken in the selection of the fruit to be used. Most of the fruits sold in the market in the early fall are not well ripened. Apples, peaches, pears, and other fruits grown in southern latitudes are gathered before they are ripe and shipped north, where they bring a high price before the northern crop is ripe. This green fruit is ripened on the cars and boats, and in cellars, warehouses, and stores, where it is shut out from the sunlight, and where the air oftentimes is not of the purest. Fruit ripened in such places is very inferior to that ripened on the tree where it grew. Fruit grown in northern sections is often gathered quite unripe, and, marketed early in the season, it brings a high price. This green fruit has not been chemically elaborated in the sunlight and fresh air on the parent stem, the only way it can obtain the proper elements in proper combination.

Of course, this green fruit is better than none, but fruit can not be perfect unless ripened as Nature intends it should be.

I was lately reading the reports of apples exported from this country to England and other countries. If my memory is not at fault, I think the number of barrels exported in 1894 and 1895 was in the vicinity of half a million. We ought not to export a barrel; the people of this country are suffering because they have not consumed them all.

There is another article of food of which we do not consume enough—namely, *baked beans*. Many people complain that they can not eat them. Well, cooked as they are in many families, they can not and ought not. Our physiological text-books have for a good many years taught that persons of sedentary habits do not require a diet that feeds and strengthens the muscles so much as those who perform muscular work. Well, perhaps not quite as much, but a great fault with the majority of people in this country is, that they do not consume enough food which feeds the muscles, brain, and nerves—i. e., nitrates and phosphates. In the first place, food can not be well chewed without muscular action; secondly, the stomach is required to exercise muscular activity as a part of the digestive process; thirdly, the peristaltic action of the bowels is indispensable; fourthly, the heart is one of the most if not the most powerful muscle in the human body; it never ceases working from the moment life begins until it ends. How can we expect this most important organ to go on year after year performing hard muscular work without being nourished by such food as muscles require? In my opinion, the many cases we hear of nowadays of heart failure are simply cases of heart starvation. We consume too much fat forming food, and the result is a shrinking and weakening of the muscles of the heart and other important organs. The muscles of the heart shrink away and fat is substituted in place (fatty degeneration). Whatever a person's occupation may be, a good supply of muscle-making, brain and nerve-making food should be daily eaten. Baked beans—properly baked—contain over twenty-five per cent of nitrates for muscles, and fully four per cent of food for brain and bones; but they must be thoroughly cooked. I would not care to eat them cooked less than twelve hours.

bedded, peaty pulp I now hold in my hand was made and filed away at a time when the mastodon came along here for food and the big American elephant shook the earth with his heavy steps. If I had time and patience, what a story this old library of primitive paper could tell me! It would be the tale of the world, who lived on it, how they lived and how they died, the story of storm and freshet and tornado, of drought and fire and famine, and the family record of every insect, mammal, and bird which has visited this field for the past seven thousand years. The proofs of the photographer fade and go out to nothing, the images of the spectroscope die with the light which created them, and the dormant words in the phonograph lisp and stutter with age and much using; but Nature's record book, which is always open and always getting new additions, holds fast to every fact, no matter how trivial it may seem, and will keep them all there in evidence until the senile earth wrinkles up, like a sun-dried lemon, and floats through space a cold and shriveled husk. This paper mill, I have found, old as it is, measures but one beat of the pendulum on the great clock of geologic time, a clock that was wound up millions of years before man came on earth, and will continue to run for millions of years after the last human being has gone.

A heavy rainfall came on before I had finished my digging, and when I visit my paper mill again it is flooded with water. Both work and study are useless here at present, and I pass an hour watching the pool, and noting how the added water has increased the activity of the aquatic animals that make it their home. All the wigglers in wigglerdom are out zigzagging themselves to the top of the water to stick their star-shaped noses up for a bit of air, and then falling to the bottom again to feed on the decaying muck. The pond seems alive with them, and the frogs are having a feast, eating wigglers by the dozen at every swallow. My ducks come waddling up from the house, and enter the pond for a swim; but, catching sight of the frogs, they conclude to abandon their bath and have a frog dinner. For the next ten minutes the water is a splashing, boiling sea, lashed into waves by fleeing frogs and pursuing ducks.

THE report of the British Association's Committee on the Teaching of Science in Elementary Schools represents that while much improvement has been made in the character of the teaching, difficulty still exists in getting it done by experiments and in a truly educational way, rather than as a series of useful but isolated facts. School teachers are generally enthusiastic in their endeavor to obtain a knowledge of science when classes are organized for their benefit. Progress is making in the number of subjects taught in elementary schools and the number of pupils receiving instruction.

Correspondence.

THE VALUE OF VEGETABLE FOODS.

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Beans should not be eaten unless one is really hungry—the appetite sharp.

Of course, there are many other articles of food which are good muscle, brain, and nerve feeders, and as a people we ought to consume more of them. I do not say that all people can eat baked beans as I do, they act as a tonic and strengthen the digestive powers in my case. I think most people can eat more of them than they do, and if properly cooked would soon find them almost indispensable. Baked peas stand next in value as a muscle and nerve food.

Before closing I wish to allude to apples again. I like them raw, but sauce is delicious made in the following way, by which method the apple loses less of its valuable qualities than in any other method of cooking them:

First, pare thin and quarter the apples, place in a stewpan over a hot fire, put in a few spoonfuls of water, just to keep from burning on the bottom—more than that injures the flavor; cook as quickly as possible; cover over when cooking, so that steam will cook the top. I have found that with a hot fire from eight to twelve minutes will cook them. Add a quantity of sugar before quite done and eat warm. When done; the apple will remain in quarters, and hardly have changed color. A fine red Baldwin apple cooked in this way and eaten before cold is delicious and very healthy. C. A. HOPPIN.

WORCESTER, MASS., *September* 2, 1895.

INDIVIDUALITY IN THE NESTS OF THE ENGLISH SPARROW.

Editor Popular Science Monthly:

SIR: One of the great factors in natural selection is individual variation. The English sparrow in its struggle for existence has to contend with cats, boys with blowguns, and the hostility of a large class of people who believe it to be a nuisance. The strength and stability of a nest in which the young are to be reared are important features in the life of the brood, and it is interesting to note the variations in the form, style, and material of the nests, in this connection. Mr. John Robinson, of Salem, has communicated to me the following observations he has made concerning this subject:

"In June, 1893, a sparrow's nest was removed from the vine (*Ampelopsis virginica*) growing on the southern end of East India Marine Hall, Salem, composed exclusively of the twigs of *Tamarix chinensis*, a tree of which species was growing in the yard below the nest. The twigs were about five inches long, and, being young and tender, were easily bitten off by the birds. Over three hundred shoots were thus used in this one nest. A little hay was used as a foundation in this nest and in each of the others to be described.

"In May, 1894, all the nests in the vine, of which there were perhaps twenty, were taken down about the 1st of the month. About the 15th of the month four nests, all made after the cleaning at the 1st of the month, were taken down. Each had a slight foundation of hay. One was composed of feathers, no doubt collected in a neighboring yard where hens were kept. About a quart of these feathers were in the nest. A second was composed entirely of twine, picked up in the streets and yards near by. A third was made exclusively of strippings of fine bark from cedar posts, and very likely obtained from the lumber dealer's storage yards on Derby Street, not far away, or perhaps from some newly set fence nearer at hand. Another nest was filled with fluffy cotton wool, such as is used in bed puffs. In each case there was nothing else used except the hay foundation and the materials named."

EDWARD S. MORSE.

SALEM, MASS., *October* 26, 1895.

Editor's Table.

THE BORDERLAND OF NONSENSE.

THAT mental stimulation may produce marked physical results is a proposition which few would be found to deny or even to question; but it is an unfortunate thing when this simple and limited truth is converted into a pretext for virtually denying the laws of physical causation, where human beings are concerned. Yet, if there is one gospel which a large class of persons hear more gladly than another, it is that the laws of matter are illusory and those of mind or spirit alone substantial and valid. Hence the numerous schools which, under various names, and with more or less pe-

cuniary success, are attempting to make faith, emotion, hallucination do work which, so far as it is within the range of possibility, belongs to a well-devised system of physical, or combined physical and mental, treatment. It looks sometimes as if, according to the well-known Latin adage, the people really did wish to be deceived; and the upholders of sound doctrine and sane methods are doubtless tempted at times to be discouraged. The thing to do in such a case is to look away from the causes of discouragement and renew the battle against delusion and imposture with more energy than before, knowing that some good must come of every manifestation of the true nature of things.

We have no quarrel, as may already have been gathered, with those who maintain that some use may be made of a wise direction of thought and a healthy stimulation of mental interest in combating various forms of physical ailment. Every competent physician does what he can to "keep up the spirits" of his patient; and the common wisdom of mankind has recognized that mental conditions have in many cases much to do with questions of health and disease. A "*mens sana*" is, we have not the least doubt, a powerful aid toward the maintenance of a "*corpus sanum*"; but, when this has been to the fullest extent admitted, it remains none the less true that the body is subject to the laws of matter, and that a given affection of our bodily organization will modify in the most important manner the action of our mind. In this respect man has no superiority over the brute: the physical causes which affect the latter affect man equally, and sometimes in greater measure, the equilibrium of the human constitution being perhaps, on the whole, less stable than that of the lower creatures. We may say of man and the lower animals what Shylock says of Jew and Christian that they are "fed with the same food, hurt with the same weapons, subject to the same diseases, healed by the same means, warmed and cooled by the same winter and summer." That man has the higher mentality does not in the slightest degree exempt him from the operation of physical laws, though it does enable him to surround his life with safeguards, and in a general way pursue and secure his well-being by methods which no other species can understand or imitate.

All this may seem to most of our readers very commonplace and obvious, but nevertheless there is need to repeat even such truths as these when we find some pages of a scientific periodical* devoted to the advocacy of contrary doctrines. "Man," we read, "is a soul which, through an inherent tendency toward articulate manifestation, has picked up a little plastic material and erected it into an animated statue. This same dust has been, and will be, used over and over again to express other and different grades and qualities of life; and therefore it can have no distinctive character or identity of its own." It seems a great pity that man being "a soul" should require the help of a little characterless "dust" in order to arrive at "articulate manifestation." How is it, we feel inclined to ask, that so poor a quality of dust should be able to render so mighty a service to a soul? It is also a question what kind of existence a soul enjoys, when, for want of what the dust can supply, "*pulveris exiqui munera*," as Horace hath it, it as yet possesses no power of "articulate manifestation." But perhaps, before we trouble ourselves with such ques-

* See New Science Review, July, 1895.

tions as these, it might be well to ask who stands sponsor for the theory that man is a soul with a power of "picking up plastic material," and by what series of observations it is claimed that the theory has been proved. To such an inquiry we hardly think any very satisfactory answer could be returned. The theory is certainly not entertained by another writer who contributes an article on The Brain in the Light of Science to the same magazine in which we find the article now commented on, and who pointedly rejects the idea that there is "something called 'intelligence' inhabiting the brain, but apart and entirely distinct from its structure."

That such views are fraught with practical danger is evident on further examination. The writer to whom we are referring will not allow that a draught can *cause* one to take cold. It can only be the occasion of taking cold; the real cause is the individual's "susceptibility." Continuing, he says: "A dozen persons are equally exposed to a contagion or malaria. Only half of them take it. Subjective conditions made the wide difference between opposite results." Again we are disposed to ask for the authority for such a statement. It is very positively made, but that it admits of any kind of proof we doubt. What we do know is that *physical* conditions affect the result in such a case. The various forms of inoculation that are constantly being practiced afford proof that, independently of all subjective conditions, diseases can, with a large measure of certainty, be either communicated to, or warded off from, a given individual by the infusion of some suitable preparation into the blood. That subjective conditions have no more to do with the case than "the flowers that bloom in the spring" is shown by the fact that the most precise results can be obtained from operations on inferior animals such as rabbits and mice. Diphtheria is being controlled in the most remarkable manner by the antitoxine treatment; and it has lately been shown that a transfusion of serum from an individual who has shown a lack of susceptibility to a given disease will tend to produce immunity to that disease in another. The writer we have quoted states in an offhand manner that susceptibility is a matter of "subjective conditions," but these experiments prove that it is a matter of physical constitution; for it will hardly be contended that "subjective conditions" are transferred from one individual to another with a little serum.

The writer, it is true, does not advise people to sit in a draught and "resolve not to take cold." He says that "temporary surface thinking, though good, if in the right direction, can hardly transform one to a perceptible degree; that radical invigoration can only come from a sustained and focalized attitude of mind, which is attained through the firm holding of positive ideals." Then, if we firmly hold positive ideals, and so get a sustained and focalized attitude of mind, we can sit in as many draughts as we choose with perfect impunity. This or nothing is the teaching of these sentences. But how are we to know whether our mental attitude is sufficiently sustained and focalized to justify us in sitting in draughts? Is there not danger lest experiments should be prematurely made? An old Scotchman in the last century, when hard drinking was the rule, said that he had never known of any man dying of drink, but that he had known a good many who had died in training for it. So it might be in this matter of training for sitting in draughts. The supreme adepts might be immune, but those whose minds were not yet adequately focalized

might succumb. And then, after all, why go to all this trouble of focalization, etc., when it is just as easy, generally speaking, *not* to sit in a draught? It seems to us that in point of simplicity materialistic teaching has, in this matter at least, a decided superiority over the spiritualistic. The believer in the laws of matter says: "If you sit in a draught, particularly when you are heated and perspiring, you will be in danger of catching cold, which *may* take the form of pneumonia, pleurisy, lumbago, or something else both dangerous and painful; therefore don't sit in a draught if you can possibly help it." The spiritual philosopher says: "Don't sit in a draught unless you are sure of your subjective conditions. Draughts do not cause illness; it is your susceptibility does that, and it should be your aim to get rid of such susceptibility by pursuing ideals and getting your attitude of mind properly focalized." A poet already quoted, who gives us many a shrewd hint, tells of a philosopher who, while gazing at the stars, walked into a well; and we should be inclined to dread some not altogether dissimilar catastrophe for the devotee of this exalted doctrine.

It is a great mistake, we are told, to say, "*I* am cold," "*I* am ill," "*I* have hurt myself." The proper phrases to use are not given, but it is implied that, if we would express the truth, we should say, "The plastic material which I, a soul, have picked up is cold, ill, etc." The body is the wicked partner that gets into these scrapes, and we should remind ourselves continually that the soul has no complicity in such misdoings. A man "may mentally say to himself—even mechanically at first until the habit is formed—I, the real *ego*, am well, I am strong, I am pure, I am perfect, disregarding adverse physical sensations." Ordinary common sense tells us that "adverse physical sensations" ought not to be disregarded, but on the contrary ought to be taken as warnings that we have violated in some way the laws of our physical nature. If we have an acute indigestion caused by taking food excessive in quantity or unsuitable in quality, we should, according to the above teaching, meet the emergency by eulogizing our soul for its strength, its purity, and its perfection, for its oneness "with the divine spirit of wholeness." Not occupying so exalted a plane as the advocate of mental healing, we should be disposed to consider the occasion a very unsuitable one for eulogizing the soul. If the soul does not direct or control the voluntary actions of the body, it is hard to see what good it is; and if our soul has allowed us to make a beast of ourselves, it would be better, it seems to us, to tell it some home truths. It is really almost too ridiculous to say that if a man gets drunk he is to "disregard adverse physical sensations," and sing a pæan, however huskily, to his *ego*; yet, where is the line to be drawn?

But again, what degree of triumph over physical phenomena may we expect to achieve? It was promised to the early believers in Christianity that they should be able to take up serpents with impunity, and that if they drank any deadly thing it should not hurt them. Is something like this the goal of the system we are discussing? Once take the position that the material is the unsubstantial, and all the foundations of our everyday life give way. The "plastic material" which the soul appropriated in order to acquire "articulate manifestation" loses all definite properties; and how that would answer the purposes of the soul is a very obscure question. As we have hinted in our headline, the whole theory under discussion lies

on the borderland of nonsense except when it crosses the line. The only saving truth it contains—and that is by no means its property—is that man is a rational creature, that his mental life is very closely connected with his physical life, and that the proper ordering of his thoughts and aims is, therefore, a matter of prime importance for his happiness. All the same, he requires a stable world to live in—one the laws of which will not permit him to be wayward or reckless, but which, while making ample return for worthy effort, will visit with penalties not to be averted, "adverse sensations" not to be conjured away by any tricks of self-hypnotization, every departure from the path of knowledge and self-control.

THE ANTHROPOLOGICAL VIEW OF CIVILIZATION.

WE commented in our last number upon the interesting address delivered by the President of the American Association for the Advancement of Science, and we have now before us an address of equal interest and perhaps of greater practical importance from the president, Dr. Flinders Petrie, of the Anthropological Section of the British Association. Dr. Petrie is widely known as one of the most learned Egyptologists of the present day, and as professor of that study at University College, London. He has spent many years in actual research in Egypt, and has thus been brought into close and varied contact with different sections of the Egyptian people. During the period of his stay in that country systematic efforts were being put forth to civilize the people according to European ideas, and, as a commencement, to teach them how to read and write; and he has been able to study the process in its practical results. In addition to his special accomplishments, Dr Petrie is a man of wide culture and of a vigorous habit of mind, and one therefore whose views are deserving of careful and respectful attention.

He discusses for us, in his address, the meanings which, from the standpoint of anthropology, should be assigned to those often vaguely used words "race" and "civilization." We must pass over his remarks on the first of these terms, though they are both interesting and original. In regard to the latter the position he takes is that wherever there was a human society there civilization is to be found. "Civilization," he observes, "really means simply the art of living in a community, the checks and counter-checks, the division of labor, and the conveniences that arise from common action when a group of men live in close relation to each other." In other words, the term has a relative, not an absolute meaning; and the practical question which confronts the so-called higher races in certain cases is whether it is desirable to replace, or attempt to replace, the relative civilization of a given lower race—or one which they regard as such—by their own more advanced modes of life.

This brings us to the most important part of Prof. Petrie's discourse. "Every civilization," he says, "is the growing product of a very complex set of conditions depending on race and character, on climate, on trade, and every minutia of the circumstances. To attempt to alter such a system, apart from its conditions, is to attempt the impossible. No change is legitimate or beneficial to the real character of a people, except what flows from conviction and the natural growth of the mind." Such conviction and such mental growth are not to be had if we present unassimilable ideas and ideals. Our intentions may be excellent, but

the results will be none the less deplorable, if we ignore the limits which Nature and history have set to our efforts. "We talk complacently," says the professor, "about the mysterious decay of savages before white men." There is nothing mysterious about it; we change their environment, we subject them to new laws, force them to adopt new habits, give an unwonted direction and exercise to their mental faculties, subject them in a hundred ways to a psychological strain which they are unable to stand, and the result is that they wither just as we should do if we were similarly treated. Of all systems, that which the Anglo-Saxon race seeks to impose upon the weaker peoples with which it comes into contact is the most oppressive. "Scarcely a single race," the professor emphatically declares, "can bear the contact and the burden." In regard to the Egyptians, he gives his own experience. "Some of the peasantry are taught to read and write, and the result is that they become fools. I can not say this too plainly: an Egyptian who has had reading and writing thrust upon him is, in every case that I have met with, half-witted, silly, or incapable of taking care of himself. His intellect and his health have been undermined and crippled by the forcing of education."

Is it impossible, then, for the more advanced races to lend any real assistance to the less advanced? It is, if the only idea of assisting them is to Europeanize them; but not, if the more rational idea is adopted of a gradual education along wholly natural lines, with due regard to conditions both present and antecedent. "Our bigoted belief," says Prof. Petrie, "in reading and writing is not in the least justified when we look at the mass of mankind. The exquisite art and noble architecture of Mykenæ, the undying song of Homer, the extensive trade of the bronze age, all belonged to people who neither read nor wrote. The great essentials of a valuable character—moderation, justice, sympathy, politeness and consideration, quick observation, shrewdness, ability to plan and prearrange, a keen sense of the uses and properties of things—all these are the qualities on which I value my Egyptian friends, and such qualities are what should be evolved by any education worth the name." The most valuable educative influence is example, if only it be of the right kind; and if the higher races could, in their dealings with the lower, show that they were steadily actuated by a purer and higher morality, they would insensibly modify for the better the institutions and customs of the latter.

The words in which Prof. Petrie describes the characteristic results of education in the best sense, and also his remarks on the effect of forcing education on minds unfitted for it, may well afford matter for reflection, not only in connection with the treatment of lower races, but with the working out of problems nearer home. In answer to the question, "What can be the harm of raising the intellect in some cases if we can not do it in all?" the professor says, "The harm is that you manufacture idiots." Now, seriously, are we quite sure that our own educational methods does not in some, nay in many, cases tend to the manufacture of idiots? Does every young man, or every second, or even every third, young man who goes through college come out of it intellectually—to say nothing of morally—stronger than he went in? When we read of the reckless and riotous insubordination that sometimes marks "commencement" days, we can not help wondering whether the right kind

of material has been gathered within the college walls, or whether, if the material is all right, the course of instruction and discipline has been what it should have been. But, this consideration apart, has the public learned to recognize in the average college graduate a very intelligent, helpful, and self-helping young man? Or does just a suspicion of greater or less silliness and incapacity attach to the type? That many bright young men emerge from college it would be foolish, even on the general doctrine of probabilities, to doubt, seeing that a young man, if he possesses any brightness, has so good a chance in this country of being sent to college; but what, we ask, is the effect on those who have no bent toward learning, but who go to satisfy a social exigency or to fill up a certain number of vacant years? We fear that Prof. Petrie might in his haste pronounce some of them manufactured idiots not unlike the Egyptians he had seen spoiled by overmuch reading and writing.

But, taking a wider view, are we sure that even the public-school education which we force on all children alike is always an aid to true intelligence and civilization? Such as it is, it enfeebles, we greatly fear, rather than strengthens the brains of some who are subjected to it, and who are not intellectually fit for the abstractions with which it largely deals. The whole subject requires to be carefully studied apart from all prepossession, prejudice, and sentiment. We have been forcing education for a long time with all the power of the state, but whether the average intelligence of the community has risen in response to our efforts is a question which it would not be safe to answer offhand. We do not hesitate to say that to us it appears as if our methods of education were being insensibly adapted to a lower and lower grade of general intelligence. In the matter of arithmetic, particularly, it seems to be assumed that something like idiocy is not only the starting point in the pupil's mind but a condition of considerable duration. Forty years ago no such elaborate means were resorted to as seem necessary to-day to get a few elementary principles of numerical logic into a child's mind; and it is a grave question whether in the attempt to devise a system of teaching adapted to the most degraded type of mind we are not running some risk of impairing the development of minds of a higher order. Exceeding bitter, we know, has been the cry of many a parent at the tedious drill and senseless repetitions imposed upon his children and the consequent needless lengthening by two or three years at least of the period of school education. The philosophy of the whole thing is apparent in the light of Prof. Petrie's remarks. The state is, to a not inconsiderable extent, engaged in the manufacture of idiots.

The discussion which followed the president's address was remarkable in one respect, and that was that among the speakers—all men of distinction—not one laid any stress, as would certainly have been done a generation ago, on the importance of Christianizing the lower races. It seemed to be assumed that Christianity, as a doctrine and to some extent as a moral system, involved too radical a change of ideas to be profitably adopted by heathen tribes, unless in a very gradual manner. The president himself pointed out that the apostle Paul had not seen it necessary to prohibit slavery, polygamy, or even gladiatorial shows. And yet the preaching of Paul prepared the way for "the greatest readjustment of the moral sense that the world has ever seen." We should learn

from this to have patience with the imperfect usages of the heathen of our day, and not insist on their rising at once to the full height of an advanced Christian morality. It is impossible to doubt that the address of Prof. Petrie will have a powerful effect in promoting rational views on the important questions with which he dealt. It was not the utterance of a partisan, a zealot, or a narrow specialist, but of a man who spoke from well-matured conviction and a broad basis of knowledge. Had the meeting of the British Association given us nothing more than this, it would have made no slight contribution to the cause of enlightenment and true civilization.

Scientific Literature.

SPECIAL BOOKS.

MAN has ever been curious about the origins of things. In the childhood of the race he wondered where the wind came from and the water in the streams, how the sun and moon were made, what caused the thunder and the lightning, and how the first plants, the first animals, and the first human beings came to be. Later the origin of arts and customs, the rise of tribes and peoples, the production of material substances, and a host of similar problems engrossed his attention. Two ways of answering these questions have been relied upon by him at different times. The first was by speculation, and produced beautiful myths, fantastic cosmogonies, quaint folklore, or pseudo-sciences, according as the genius of one people differed from that of another. The second way depends upon research, and has reached its highest development in the investigations of modern science. Its inquiry into the past has given us a wealth of archæological lore such as is embodied in two volumes now before us. In one of these Prof. *Mason** has set forth the results of a study of industry among primitive peoples, revealing the manner in which the tools, devices, and processes used in the arts must have originated. The arrow and spear heads, knives, hammers, and axes of primitive man are the precursors of a host of striking and cutting implements. Several kinds of drills have been found in use by savage tribes. The screw, the pulley, and the wheel and axle are known to savages only in a rudimentary way, but the lever and the wedge are largely used by them. Modes of kindling and caring for fire make an interesting chapter, a notable feature in which is the evolution of the bellows. The use of stone is commonly thought of as characterizing primitive arts, and this idea is embodied in the name "Stone age." This is a misconception, for, as Prof. Mason points out, where one tool of stone was used there were many constructed of the more easily worked materials, wood, bone, shell, horn, and hide. We do not find them in ancient graves and mounds, simply because their materials are much more perishable than stone. Hence, while stone-working furnished wide scope for invention in

* The Origins of Invention. By Otis T. Mason, Curator of the Department of Ethnology in the United States National Museum. Pp. 419, crown 8vo. London: Walter Scott, Ltd., 3s. 6d. New York: Imported by Charles Scribner's Sons. Price, $1.25.

primitive times, the working of wood did no less. The potter's art originated early, and the forms of primitive pottery are an ever-pleasing surprise to the archæologist and the technographer. The same is true of the textile industry. In producing implements of war and the chase invention made important advances in primitive times, and material is not lacking to show how facilities for travel and transportation, both by land and sea, arose. Coming to the end of the volume, we are impelled to query why the author made his index so scanty, and why he divided it in the inconvenient German fashion.

The other of the two books referred to above is concerned with the art of writing.* The important aid which this art gives to man's progress by preserving the experience of each generation to guide all that follow makes it well worthy of separate treatment. The art of transmitting intelligence proceeds from objects serving as reminders through picture writing to phonetic writing with an alphabet. The author has presented this course of development especially as it is shown among the native races of North America, from the Innuit in the north to the Mayas and ancient Mexicans in the south, among whom all stages are represented. Illustrations are frequently drawn also from the Egyptian and other Oriental peoples. It is easy to see how objects can be represented by pictures, and savage races have shown themselves very clever in representing action by the same means. Thus in many of the Ojibwa records going, or running, is represented by drawing either the sole of the foot or the lower part of the legs. In the Mexican codices a distinction between running and walking is denoted by placing the legs in the correct position in each case. The sign for eating or food among several peoples consists of a human figure with the hand placed to the mouth. Lines proceeding from the mouth of either a human or animal figure denote the use of the voice. Adding the figure of the heart within the outline of the human body makes the voice lines mean singing. Similarly wavy lines from the ears denote hearing. To distinguish an object used as a proper name, a human figure or the head alone is placed below it with a line from the mouth to the name object. Such signs gradually become conventionalized and reduced to simpler forms. When the name or sound suggested by one object comes to be joined with another such sound to denote a word having only a phonetic relation to the names of these two objects, then the ideograms become phonograms. Further progress in this direction converts the phonograms into alphabetic characters. At the discovery of America the writing of the Mexicans and Mayas was rapidly approaching the syllabic stage. The only phonetic alphabet actually devised by aboriginal Americans is that of the Cherokee, Sequoya, but this uses the forms of the Roman letters variously modified, and hence is not an independent creation. Dr. Hoffman's volume contains four plates and over a hundred smaller figures, and is adequately indexed.

The world is beginning to realize that "Peace hath her victories no less renowned than war," and in consequence its appetite for butchery seems to be abating. A set of books called the Century Science Series, that has been

* The Beginnings of Writing. By Walter James Hoffman, M.D. Anthropological Series. Pp. 209, 12mo. New York: D. Appleton & Co. Price, $1.75.

undertaken under the able editorship of Sir Henry E. Roscoe, will contribute to this result by showing that the laboratory and the explorer's camp have their heroes as well as the battlefield. Sir Henry contributes the opening volume to the series, taking as his subject his eminent British predecessor in the field of chemistry, *John Dalton*.* Dalton's great contribution to chemistry is the atomic theory, and it may be fairly ranked as the corner stone of the science. He also established important laws concerning the behavior of gases and made valuable meteorological researches. In depicting the scientist, Sir Henry does not let us lose sight of the man. He shows us Dalton as the Cumbrian Quaker lad, with his northern dialect and mild though unpolished manners; then as the young schoolmaster and the tutor, careful of his scanty resources and no less so of his time; afterward as the plain and unpretending man of science, ever ready for a pipe and a chat with the friends of old times, but with no faculty for being agreeable to persons who did not interest him. Having, when a young man, bought a pair of silk stockings as a present for his mother, supposing them to be of orthodox drab, he was greatly astonished to hear them pronounced "Varra fine stuff, but uncommon scarlety." It was in this way that his eyes were opened to the defect of his vision, and he at once proceeded to make the first scientific study of color-blindness. Dalton had the frame of a northern yeoman, high but not extraordinary mental powers, and—*perseverance*. To this last quality rather than to genius he ascribed whatever of value he accomplished, and in this respect he seems to have judged correctly.

Is the story of the *Herschels*† especially dramatic, or is it Miss *Clerke's* talent as a narrator that makes her contribution to the Century Series a remarkably fascinating volume? William Herschel's laying down the baton of a musical director to become an astronomer is dramatic enough, and so is his sister's dutiful abandonment of a career as a vocalist to serve as his assistant. William had been trained in music by his father, who was bandmaster in a Hanoverian regiment; he had proved a bright boy at school, and when he went to England at nineteen years of age was a young man of pleasant address, "who spoke English perfectly, played like a virtuoso, and possessed a curious stock of varied knowledge." Miss Clerke has made a continuous story of his life, intertwining the thread of his musical and that of his scientific vocation, where these are contemporaneous, with that of his personal history. A chapter devoted to Caroline tells of her early years as a family drudge and her quarter century of retirement after her brother's death, supplying also some additional details of her co-operation in his labors. The sketch of Sir John Herschel is given in much the same style as that of his father. While mainly occupied with his observations in the southern hemisphere and other astronomical labors, it tells also of his work in physics and mathematics, and his writings—not omitting his verse. The volume contains a portrait of each of its subjects.

To those who imagine that the name *J. von Liebig*‡ stands merely for a manufacturer of meat extracts, who may still be conducting his works

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* John Dalton and the Rise of Modern Chemistry. By Sir Henry E. Roscoe. Pp. 216, 12mo. New York: Macmillan & Co. Price, $1.25. London: Cassell & Co. Price, 3s. 6d.

† The Herschels and Modern Astronomy. By Agnes M. Clerke. Pp. 224, 12mo. New York: Macmillan & Co. Price, $1.25. London: Cassell & Co. Price, 3s. 6d.

‡ Justus von Liebig: his Life and Work. By W. A. Shenstone. Pp. 219, 12mo. New York: Macmillan & Co. Price, $1.25. London: Cassell & Co. Price, 3s. 6d.

somewhere in Germany, Mr. *Shenstone* has a message. He wishes them to know who Liebig was, what he did, and why all chemists and all those who are versed in the history of science admire and esteem him so greatly. To this end our author has taken especial pains to set forth Liebig's applications of chemistry to the arts, even at the expense, as he concedes, of doing "something less than justice" to the great German's labors in pure science. Liebig was the son of a color-maker, who was able to give him a university education, but this was of little benefit to him in becoming a chemist. His private studies, supplemented by admission to Gay-Lussac's private laboratory, prepared him for his profession. Mr. Shenstone enumerates four great departures in which Liebig took the lead. First, he devised the process now followed in analyzing organic compounds, and with this as an implement he determined the composition and discovered cheaper and safer ways of making many substances important to science and industry. Second, he showed that plants derive their nourishment not so much from the humus as from the inorganic salts in the soil and the carbon dioxide of the air, and went on to formulate rules for the making and application of fertilizers and for the practical conduct of other agricultural operations. His third great work was closely connected with this. It related to physiological chemistry, taking up the office of the food of animals in producing tissue, maintaining the animal heat, etc. Liebig's fourth great departure was introducing the laboratory method of teaching chemistry. This alone would have won him high fame. Mr. Shenstone does not dwell upon Liebig's private life, but gives an insight into his combative but generous character when telling of his collaboration with Wöhler and with Dumas, also in the chapter on his later years. Accounts of the work of Faraday, Maxwell, Lyell, Davy, Pasteur, Darwin, and Helmholtz are announced as in preparation, and if they are executed as acceptably as the earlier volumes, this series will be a notably attractive and instructive one.

The multiplication of untechnical, familiar books about flowers, whether of the garden, field, or forest, is a good sign. It shows that more and more people are growing interested in the subject, and that those who have not had opportunity to take a course in botany, or whose time, or eyes, or patience are not sufficient to enable them to plod through the mass of minute details involved in the technical identifications of the manuals, want to know what they are and what their relationships. Mr. *Mathews*, author of *Familiar Flowers of Field and Garden*,* enjoys a point of observation farther north than do most of the others who have given us books of this kind, writing from Campton, N. H., on the edge of the Franconia Mountains. There he has a garden in which most of the western and southwestern wild flowers are cultivated, while the wild flowers of New England grow in the fields and woods around. With these he spends much time; and in this book he attempts to introduce them to the reader by name and familiar description and picture, and to supplement the introduction by a little friendly gossip based on personal experience. These flowers are treated according to the seasons and months in which they appear; while

* Familiar Flowers of Field and Garden, described and illustrated by F. Schuyler Mathews. Pp 308, 12mo. New York: D. Appleton & Co. Price, $1.75. London: Kegan Paul, Trench, Trübner & Co.

the illustrations—simple portraits, generally reduced as befits the size of the page—are from drawings made on the spot. The author seems to hesitate when he differs from Dr. Asa Gray, but he need not. If he has seen the Atamasco lily in bloom in May, while Gray had not the opportunity so to see it; if he finds a certain aster, supposed to be peculiar to southern New England, common in New Hampshire; if he finds colors and shadings which Gray knew not, or has a clearer vision of their distinctions; or if he knows other facts or has seen other qualities in flowers which Gray did not, he is able to add to knowledge, it is his duty to tell of it, and he deserves thanks. An alphabetical index at the end of the book gives the names, colors, and localities of familiar flowers of the United States, with a floral calendar.

GENERAL NOTICES.

The *Haandbog i den Systematiske Botanik* of Dr. *E. Warming* has long been recognized as an original and important contribution to the literature of the subject. The present translation, by Prof. Potter,* from the third Danish edition and from Dr. Knoblauch's German edition, has been enriched by numerous additional notes kindly furnished by the author. Besides Dr. Knoblauch's revision of the fungi, the bacteria have been revised by Dr. Migula, the Florideæ rearranged after Schmitz, and the Taphrinaceæ after Ladebeck. Instead of rearranging the orders of the Angiosperms according to the systems more familiar to English readers, the sequence in the Danish original is retained. One of the principles of this arrangement is thus defined by the author: "Each form which on comparative morphological considerations is clearly less simple or can be shown to have arisen by reduction or through abortion of another type having the same fundamental structure, or in which a further differentiation and division of labor is found, will be regarded as younger, and as far as possible, and so far as other considerations will admit, will be reviewed later than the simpler, more complete, or richer forms." In an appendix are given an outline of some of the earlier systems of classification and a more complete account of that of Hooker and Bentham. A full index is provided.

* A Handbook of Systematic Botany. By Dr. E. Warming. With a Revision of the Fungi. By Dr. E. Knoblauch. Translated and edited by M. C. Potter, M. A., F. L. S. With 610 Illustrations. Pp. 620, 8vo. London: Swan, Sonnenschein & Co. Price, 15*s*. New York: Macmillan & Co. Price, $3.75.

The plan and general character of Prof *Vines's Student's Text-book of Botany* were explained in our notice of the first half volume in the Popular Science Monthly for July, 1894. This work is completed in the second half volume,* now before us. The subject of classification is continued, beginning with Group IV, *Phanerogamia* (or *Spermophyta*)—the preceding groups including the *Thallophyta*, *Bryophyta*, and *Pteridophyta*—and completed, and the physiology of plants is considered. The province of physiology is defined by the author as being "the study of those phenomena which, taken together, constitute the life of the plant; in other words, while morphology is concerned with what plants are, and histology with their structure, physiology deals with what they do." The performance of their functions by the organs of the plant being materially affected by various external conditions, "the object of physiology is not only to distinguish and study the various functions and to determine the relation between them and their internal structure and the external forms of the organs performing them, but also to determine what are the external conditions by which the performance of the external functions is affected, and the modes in which these conditions exert their influence." A very complete index is given in two parts, "Classification and Nomenclature," and "Morphology, Anatomy, and Physiology."

* Student's Text-book of Botany. By Sydney H. Vines, M. A., D. Sc., F. R. S. With 469 Illustrations Pp. xvi + 431-821, 8vo. London: Swan, Sonnenschein & Co. Price, 7*s*. 6*d*. New York: Macmillan & Co. Price, $2.

The chief features of our strange south western region—its pueblos and cliff-dwellings, its Zuñi, Navajo, and other native inhabitants, its plateaus, buttes, and canyons, and foremost of its natural features the Great Canyon of the Colorado River—have been made familiar of late by the reports of many explorers. To Major *J. W. Powell* * belongs the credit of making the first extended exploration of the Great Canyon and the region through which it passes. This he did in the years 1869 to 1872. His report of the scientific results then obtained and a brief popular account of the exploration have been published. He has now prepared a full history of the expedition, with descriptions of the scenery, of the Indians and their customs, of the ruins and relics, and other subjects of interest in the region traversed. The volume is fully illustrated, its list of illustrations occupying more than five pages, and it is printed on heavy paper with wide margins.

Prof. *W. O. Crosby's Tables for the Determination of Common Minerals*, which appeared in 1887, has now reached a third and enlarged edition. In the new issue provision has been made for the more ready and accurate testing of streak, hardness, and specific gravity. Twenty-five additional species have been included with the two hundred in the original tables, supplementary tables comprising one hundred of the less common minerals have been added, and a synopsis of the classification of minerals has been inserted. These additions, the author believes, will reduce to a minimum the necessity of reference to comprehensive works.

It appears from the *Sixth Annual Report of the Missouri Botanical Garden* that the course of instruction in gardening was completed by one student in 1894, and another left before the end of his course to take a position at the Pennsylvania State College. In response to many applications it was decided to admit paying pupils in addition to the six on scholarships. The Shaw School of Botany and other branches of the garden's work were carried on as usual. Appended to the report are five papers on botanical subjects, illustrated with fifty-six plates, and the volume contains also several views of attractive spots in the grounds.

The Second Annual Report of the Iowa Geological Survey embraces an account of the work done in 1893 by the survey and is accompanied by several special papers. Among the subjects specifically treated are the cretaceous and certain other deposits within the State, glacial scorings, and buried river channels. The Composition and Origin of Iowa Chalk is discussed by Samuel Calvin, the State Geologist. The geology of two counties is described by the assistant geologist, Charles R. Keyes, who has also written several of the other papers.

The Cause of Warm and Frigid Periods is discussed by *C. A. M. Taber* in a little book of eighty pages (Ellis, Boston). From an experience of twenty years spent in whaling voyages in early life the author has been brought to ascribe great influence to winds and the surface currents of the sea in modifying climate. He has carefully examined the extant theories concerning the glacial period, and gives his reasons for not finding any of them entirely satisfactory.

A Brief Descriptive Geography of the Empire State, by *C. W. Bardeen*, consists of a systematic and concise but attractive description of the natural and political features of the State of New York, sadly marred by a great lot of cheap, smudgy pictures. Teachers who have any regard for the artistic sense or the eyesight of their pupils will let this book severely alone. (Bardeen, 75 cents.)

To the series of English classics edited by A. J. George and published by D. C. Heath & Co. have been added *Webster's First Bunker Hill Oration* (20 cents) and *Burke's Speech on Conciliation with America* (30 cents). Mr. George is of the opinion that the annotating of English literature for students has often been injudiciously done. Accordingly, instead of placing a surfeit of biographical, historical, and critical material under the eyes of the pupils, he has shown where this matter may be found, thus giving them valuable intellectual exercise in getting it and preventing mental dyspepsia from bolting unmasticated facts.

M. *Stanislas Meunier*, of the *Jardin des Plantes*, Paris, has been for many years engaged in the study of what he calls *Comparative Geology*, which he defines as having the

* Canyons of the Colorado. By J. W. Powell. Meadville, Pa.: Flood & Vincent. Pp. 400, quarto. Price, $10.

same relation to the geology of the earth as comparative anatomy to the anatomy of man. His special application of it is to the geology of the planets compared with that of the earth. The fruits of his studies are now embodied in a book bearing that title, which is published by Félix Alcan, Paris, in the French International Scientific Series. Though the materials for such a study may at first sight seem lacking, M. Meunier has found enough, in the results of telescopic and spectroscopic and other observations, particularly of the moon and Mars and the examination of meteorites, to make possible a fairly distinct outline, and to prompt further inquiry into this field.

In the *Report of the Commissioner of Education for 1891–'92* most of the statistics are relegated to the second volume, while the first volume is devoted mainly to essays on special subjects. Among the more extended of these are an account of the modes of training teachers employed in Germany, Austria, and Switzerland, by the able educational writer Dr. L. R. Klemm; also a description of German universities translated from a book prepared for the German educational exhibit at the Chicago Exposition, and a suggestive paper on preparation for the civil service in France and Prussia, by W. F. and W. W. Willoughby. James C. Boykin contributes an essay of nearly a hundred and fifty pages on Physical Training, half of which consists of a history of the subject from the siege of Troy to Dio Lewis, while the rest is of greater practical value, consisting of descriptions of various modes of training in present use, with illustrations and statistics. Coeducation is treated by A. Tolman Smith, who supplements his discussion with a large number of opinions of educators and a bibliography. The summer schools have now become so important that a history of them comes in very appropriately here. It was prepared by W. W. Willoughby.

The treatise on *Rocks and Soils*, by *Horace Edward Stockbridge*, has come to a second edition (Wiley). The author, who held a professorship in the Imperial College of Agriculture at Sapporo, Japan, when the first edition appeared, is now President of the Agricultural College of North Dakota. Numerous changes and additions have been made in the new edition, which may be found by a comparison with the former edition.

Home Geography for primary grades, by *C. C. Long* (American Book Company, 25 cents), is a thoughtfully arranged introduction to the study of this science. The aim is to give the child object lessons by the use of the surrounding landscape; by directing his attention to some neighboring hill, impress the idea mountain upon him; some small level space indicates a plain; a brook represents a river, a pond or lake the ocean, etc. The idea is a good one, and is well carried out.

How the Republic is Governed, by *Noah Brooks* (Scribners, 75 cents), consists of a brief consideration in small compass of the fundamental principles which direct our actions as a nation. Among the special topics are The Federal Constitution; The Government of the United States in its Three Departments—Legislative, Executive, and Judicial; National and State Rights; the Indians; Patents and Copyrights; Pensions; Declaration of Independence, and the Constitution.

Another attempt to solve the problem of gravitation is made by Mr. *Robert Stevenson* in his paper, *A New Potential Principle in Nature—Elasticity a Mode of Motion.* His principle comprises kinetic energy in the line of motion of a body, and kinetic stability tending to prevent displacement transverse to that line. The latter acts partly as a force of restitution to the original direction, with the resultant of causing a curvilinear motion. The author conceived his idea while he was a student of Sir William Thomson.

Notes on the Geology of the Island of Cuba is based upon a reconnoissance made by the author, Mr. *Robert T. Hill*, for Alexander Agassiz. Mr. Hill spent about a month on the island, accompanied by some American engineers who were familiar with the country, and who, by reason of their knowledge, were of great assistance to him. Going into the interior to Villa Clara, to acquaint himself with that region, he examined the features of the older nucleal area of Cuba; then made a thorough study of the cut of the Yumuri River at Matanzas, and of the limestone formations of the vicinity; investigated the geology of Havana; and

made a north and south section across the island from Havana to Batabanos. Going to Baracoa, he examined the country west of Yunque Mountain and east to Cape Maysi. Having completed his work of an original examination of the phenomena, uninfluenced by preconceived hypotheses, he read what others had written of Cuba, and was pleased to find a general agreement between their views and his. The notes are published by the Harvard Museum of Comparative Zoology.

Self Culture is the name of a monthly magazine devoted to the interests of the Home University League, edited by *Edward C. Towne* and published by the Werner Company, Chicago and New York. Among the subjects of articles in Vol. I, No. 2, are: Eli Whitney, a Shakespeare of Invention; The Supposed Electrical Character of Vitality; The Principle of Evolution in Nature; Primitive Man; The Story of the Plague in History; The Genius of Shakespeare; Diphtheria and the Schools; and Athletic Exercises in Universities. (Price, 30 cents; $3 a year.)

Under the title *The Essential Man*, an argument in support of the belief in immortality is presented by *George Cromwell Cressey* (Ellis, 75 cents). Among the circumstances which he deems indicative of a future life are the great difference between the mind of man and the material forces, the fact that no force is ever destroyed, the eventual cessation of all physical life on the earth, and the general diffusion of the doctrine in one form or another.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Delaware College. Tests of Sorghum Varieties. By C. L. Penny. Pp. 24.—Iowa: Agricultural College. No. 28. Nine articles. Pp. 8.—Nebraska: The Conservation of Soil Moisture by Means of Subsoil Plowing. By T. L. Lyon. Pp. 8, with Plates.—North Dakota: Weather and Crop Report for September, 1894. Pp. 17.—New York: Rules concerning Gratuitous Chemical Analysis. Pp. 3.—Strawberries, Raspberries, etc. Pp. 20.—Ohio: Report for 1894. Pp. 12 + xiii.

Becker, George F. Reconnoissance of the Gold Fields of the Southern Appalachians. Washington: Geological Survey. Pp. 86.

Bolton, H. W., Editor. The Pulpit Herald. A Monthly Magazine. Vol. I, No. 1. October, 1894. Chicago: F. W. Clement & Co. Pp. 40. 20 cents; $2 a year.

Baker, Frank Collins. The Naturalist in Mexico. Chicago: David Oliphant. Pp. 145.

Columbia College School of Mines. General Information, 1895–'96. Pp. 28.

Cornish, Vaughan. Practical Proofs of Chemical Laws. London and New York: Longmans, Green & Co. Pp. 92. 75 cents.

Correspondence School of Technology, Cleveland, O. Announcement for 1895–'96. Pp. 59.

Cramer, Frank. On the Cranial Characters of the Genus Sebastodes (Rock Fish). Leland Stanford, Jr., University, Palo Alto, Cal. Pp. 38. 35 cents.

Crawford, F. Marion. Constantinople. Illustrated by E. L. Weeks. New York: Charles Scribner's Sons. Pp. 79. $1.50.

Defender, The. Tariff Facts for Speakers and Students. New York: American Protective Tariff League. Pp. 158. 10 cents.

Diller, J. S. Mount Shasta a Typical Volcano. American Book Company. Pp. 32. 20 cents.

Dreher, Julius D. Education in the South. Some Difficulties and Encouragements. Pp. 35.

Eccles, A. Seymour. The Practice of Massage. Its Physiological Effects and Therapeutic Uses. London and New York: Macmillan & Co. Pp. 377.

Ethnologisches Notizblatt (Ethnological Notices). Published under the Direction of the Royal Museum für Völkerkunde of Berlin. No. 2. Illustrated. Pp. 160, with Plates.

Godard, Harlow. An Outline Study of United States History. Syracuse, N. Y.: C. W. Bardeen. Pp. 146. 50 cents.

Green, Mary E., M. D. Food Products of the World. Chicago: The Hotel World. Pp. 260. $1.50.

Guerber, H. A. Myths of Northern Lands. American Book Company. Pp. 319. $1.50.

Grimes, J. Stanley, Chicago. The Radiate Theory of the Cause of Gravitation. Pp. 9.

Hale, E. M., M. D. Hydrostatic Heart Therapeutics. Chicago. Pp. 16.

Holbrook, Dr. M. L. Physical, Intellectual, and Moral Advantages of Chastity. New York: M. L. Holbrook & Co. London: L. N. Fowler & Co. Pp. 120. $1.

Iowa Geological Survey. Lemuel Calvin, State Geologist. Third Annual Report, with accompanying Papers. Des Moines. Pp. 407, with Maps.

Jordan, David Starr, and others. The Fishes of Sinaloa. Palo Alto, Cal.: Leland Stanford, Jr., University. Pp. 48, with Plates.

Lloyd, John Uri. Etidorhpa, or the End of Earth. Cincinnati: John Uri Lloyd. Pp. 376. $4.

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Fragments of Science.

Constituents of Ocean Bottoms.—In his summary of the results of the Challenger Expedition, Dr. Murray classifies marine deposits as littoral, shallow water, and deep sea. Such deposits are, in origin, either land-derived or pelagic—that is, of the ocean. The land-derived deposits edge the shores, for the finest river mud is rarely met with as far as three hundred miles from the coast, and particles so large as to be called sand remain close to it. Regarded in this light, the whole ocean beyond the three-hundred-mile belt of "territorial waters" possesses a distinct individuality, invaded by no material of land origin except the mud and boulders carried by drifting ice, the dust which settles out of the air, and scraps of floating pumice from volcanic eruptions. In a few patches less than seventeen hundred fathoms deep, far from land, the remains of relatively large and delicate shells which lived on the surface abound at the bottom, mixed with innumerable shells of dense, nearly microscopic foraminifera and a little clayey matter, the whole receiving the general name of pteropod ooze, from the characteristic shells of pteropods which occur in it. In deeper waters no pteropod or other delicate shells are found, and the calcareous meal of foraminifera, closely resembling softened chalk, is called globigerina ooze, from the particular genus of surface-living organism which occurs in largest proportion. At greater depths globigerina ooze is found in which the microscopic shells appear much corroded; and finally, in the deeps or areas more than three thousand fathoms below the surface, the deposit is almost free from carbonate of lime, and forms a stiff red clay composed of decomposed volcanic or atmospheric dust and those constituents of shells that are not readily dissolved by sea water. The process of formation has been clearly shown. Over the whole surface the same shell-bearing creatures die in myriads; their bodies fall continuously as a gentle calcareous snow shower through the water, which slowly dissolves them. The large thin shells vanish first, and only reach the bottom in shallow water; the dense spheres of the pinhead and smaller foraminifera resist longest, and only the insoluble residue reaches the greatest depth. Thus the excess of carbonate of lime dissolved in the deepest layers of the ocean is readily explained. The red clay forms so slowly that particles of metallic dust from exploded meteorites, which are covered up by the surface accumulations

everywhere else, form an appreciable proportion of its substance. In places where silicious organisms like sponges and radiolarias are numerous on the surface, their glassy spicules form a considerable ingredient in the red clay, which, when the proportion reaches a considerable value, is called radiolarian ooze. Again, in the cool and less saline water of the southern ocean, and in other cases where the water is freshened, the microscopic, silica-sheathed, self-moving plants known as diatoms swarm in such vast numbers that the deposit consists in very large degree of their shells. When the proportion reaches one half it is described as diatom ooze. The red clay covers about fifty-one million square miles of the ocean floor; globigerina ooze is spread over about fifty million square miles; and diatomooze occupies a belt encircling the globe in the southern ocean, with a total area of about ten million square miles. These three kinds of deposits are thus believed to spread over a surface twice as extensive as all the land of the earth. The terrigenous or land-derived deposits occupy about nineteen million square miles, and one of the strongest arguments for the existence of an antarctic continent is the fact that they border the belt of diatom ooze on the southward wherever it has been passed.

Tenacity of Old Rituals.—While exploring an ancient cemetery near Cuzco, Peru, Mr. George A. Dorsey observed a curious ceremony performed by the Quichua Indians which illustrated to him the tenacity with which the old rites are held, and the manner in which recognition of living spirits of the dead and sacrifice to them still prevail. The men had been unwilling to assist him in disturbing the tombs of the dead, because they contained the remains of their ancestors, to remove which would be sacrilege, but were drafted into his service by a peremptory order from the prefect. On approaching the tombs the men knelt and pronounced in unison an invocation which began with a recital to the spirits of the chiefs as sons of the great Pachacamac of the doctrine of the Trinity and continued with the address: "Chiefs, sons of the sun, we have not come to disturb your tranquil sleep in this your abode. We have come because we have been compelled by our superiors; toward them may you direct your vengeance and your curses!" Then they made offerings of coca, aguardiente, and chicha, and called on a lofty, snow-capped mountain, Sancahuara, to witness the truth of their invocation.

A New Bear.—A new bear is mentioned by William H. Dall, in Science, as having been observed frequenting the vicinity of the glaciers of the St. Elias Alpine region. It is regarded by the Indians and hunters as distinct from both the black and the brown bears of Alaska. It is not large, no skin being more than six feet long, is shy, and not so fierce as the other bears. Its general color resembles that of the silver fox. The fur is not very long, but is remarkably soft; and it has a rich bluish-black under fur, while the longer hairs are often white, at least in the distal half. The dorsal line, the back of the ears, and the outer faces of the limbs are jet-black. The sides, neck, and rump are black and silver. The under surface of the belly and the sinuses behind the limbs are grayish white or pure white. The bright tan color of the sides of the muzzle and the lower fore part of the cheeks is invariable, and has not been seen by Mr. Dall in any other American bear. The structure of the claws is adapted to the climbing of trees. Mr. Dall believes that it is at least a well-defined local race, and proposes for it the racial name of *Emmonsii*. The Sitka fur dealers call it the glacial or blue bear. The Indians speak of another animal, unknown to naturalists, as inhabiting the higher mountains of the mainland. It is described as resembling the mountain goat, with horns nearly as long, but almost straight.

Agriculture on City Lots.—A satisfactory report upon the working of the experiment tried in Detroit in 1894, of engaging the poor and unemployed of the city in the cultivation of vacant lands and lots, is published by the Sterling Publishing Company, New York. About four hundred and fifty acres, or seven thousand city lots, were divided into quarter- and half-acre tracts, and about three times as many applications for allotments were received as could be granted. The crops were planted, cultivated, and harvested by the

people themselves, under the supervision of the committee; about nine tenths of the pieces were well taken care of. The committee estimate that the potato crop averaged about fifteen bushels per lot, giving fourteen thousand one hundred and seventy-five bushels in all; and large quantities of beans, turnips, and other vegetables were raised and daily consumed, of which no record was made. The estimated value of the crops produced was from twelve to fourteen thousand dollars, to say nothing of the potatoes that were eaten before they had attained any considerable size. The entire cost to the committee was thirty-six hundred dollars, a sum that was made up by subscriptions. "Should the experiment be continued, it is best to get tracts of as many in a piece as possible, and, if poor land, to collect the sweepings of the streets to be put upon the land in the spring or carry it upon the land from time to time as collected to enrich the soil. . . . It is believed that with the experience gained this year, the plan could in many respects be improved and the cost greatly reduced by beginning it in time. The committee finds that about one third of an acre is sufficient land for a family to raise enough potatoes to last them through the winter and furnish vegetables through the summer." It should be recollected that the experiment was tried under many disadvantages. It was a step in the dark; vacant city lots are in appearance the most unproductive soil imaginable; the planting was not begun till late in June, and the season was one of the worst for garden crops which the country had had for many years. Yet the success was great. A like success is claimed for a similar experiment tried in Buffalo, N. Y., in 1895. Many problems of economy, morals, and good taste would be solved if the system should become general and permanent.

Onyx Marble.—The stone called onyx marble, which is much used now in ornamental articles of furniture, is really a calcareous or lime rock, which has been deposited as a travertine or tufa from water in which it was held in solution. Water, while it can not alone dissolve lime rock, can take up considerable quantities of it when it holds carbonic acid in solution, but must drop it again when the carbonic acid has escaped. Both these processes are of common occurrence, and hence, in the springs where they are going on, tufas or travertines are formed. We know this much of what takes place, but we do not know, says Mr. George P. Merrill, in his paper on this subject, just what are the conditions governing the compactness and condition of crystallization of the deposit—why in some cases it should be susceptible of an enamel-like polish, and in others should be light and tufaceous. Onyx marble is also found in caves as a constituent of the stalagmites and stalactites which grow there, and much in the same way as in the springs. Water charged with carbonic acid percolating through the roof of the cave brings down dissolved limestone, hangs in drops to the roof, is evaporated or loses its carbonic acid, and leaves a calcareous deposit to be enlarged by continuous accretions. It rarely happens that all the water evaporates from the ceiling of the cave. Some of it usually falls to the floor, whence it is in its turn evaporated and leaves there a continually growing deposit—a stalagmite. As the water in percolating through the roof dissolved only the pure lime carbonate, or took up only a trace of impurity, these stalactitic and stalagmitic deposits are of purer lime, refined and recrystallized under new conditions. It follows almost from necessity from their mode of origin that the beds of onyx marbles, both spring and cave deposits, are as a rule far less extensive and regular in their arrangement than are the ordinary stratified and imbedded marbles. Spring action is more or less intermittent, and the place of discharge, as well as the character of the deposit, is variable. The deposit usually takes the form of a comparatively thin crust, conforming to the contours of the surfaces on which it lies. The various layers thicken and thin out irregularly, and are often lenticular in cross-section. Sound and homogeneous layers of more than twenty inches in thickness are not common. A marked and beautiful feature of the onyx marbles in general, and particularly of those which originate as spring deposits, is the fine, undulating parallel bands of growth or lines of accretion shown on a cross-section, which are due to its mode of origin through successive depositions upon the surface. The stone owes

its chief value for decorative purposes to its translucency, fine venation, and color. Sometimes the original hues have become enhanced by oxidation and through the development of reticulating veins of small size, into which percolating waters have introduced new coloring substances or locally oxidized the protoxide carbonates which seem to form the chief colouring constituent. The finer grades of stone of this type are obtained from few and scattered localities, and, except those that are of cave origin, generally, so far as the author has observed, the most eminently desirable for ornamental purposes are from hot and arid countries and regions not far distant from recent volcanic activity.

Giant Mountain Plants.—Two Swiss botanists, MM. Sommier and Sevier, who have recently explored the Caucasus, tell of the discovery of a mountain flora of giant herbaceous plants, of which little was known before, and which they designate as *macroflora*. At the altitude of about fifty-eight hundred feet some plants reach a size which they never attain in the valleys. A campanula, which does not exceed about two feet below, grows to about six feet at that height, with an unpliable stem. The large, kidney-shaped leaves of a valerian are borne at the end of petioles so rigid that they can be carried as parasols. These fields resemble the pampas, and the rocks are hidden in a growth of large plants of different kinds. The luxuriance of this vegetation is ascribed by the authors partly to the extraordinary fertility of the soil, from which the accumulated mold of ages has never been removed; while, as a second way of accounting for them, they are regarded as survivals of the grand flora of some former geological age.

A New Race of Ancient Egyptians.—The continued explorations of Mr. W. Flinders Petrie on the west side of the Nile below Thebes have resulted in the discovery of what he regards as a hitherto unknown race of men, who probably lived in Egypt about five thousand years ago. In the near neighborhood of sites yielding potteries of the best known Egyptian dynasties he found the remains of a town, with cemeteries of which about two thousand graves were excavated, in which there was not a single Egyptian object or the trace of the observance of any Egyptian custom. The bodies, instead of being mummified or buried at full length, were contracted, with heads to the south and faces to the west. They were of fine physiognomy, without prognathism; of remarkable stature—some being more than six feet high—and of development of legs indicating a hill race; with brown and wavy but not crisp hair, aquiline nose, and long, pointed head. No hieroglyphics or characters suggesting writing were found, beyond a few scratches on vases. Their vessels were perfect in form—all hand-made—yet their art was of the rudest. A picture in monochrome on one of the vases represents a boat with two cabins, rowed with oars, bearing the ensign of five hills, with ranges of hills on either side, and ostriches striding along. A game of ninepins was found, in which the pieces are formed of stone, with balls of syenite about the size of peas. The people used green paint made from malachite for marking their eyes, and many of the slate palettes on which this was ground were found. Their funeral rites appear to have included a kind of ceremonial cannibalism. They are supposed to have lived about the time from the seventh to the ninth dynasties. In the same region, in a spot exactly resembling the river gravels of England and France, large quantities of similar palæolithic remains were found.

Signs of the Times.—In an article under the above title, by Edward Atkinson, in the August number of the Engineering Magazine, is the following comment on the recent celebration of the opening of the ship canal at Kiel: "There is something rather grotesque in the picture which the nations have made at the opening of the ship canal at Kiel. The object of that canal is mainly to promote commerce, to facilitate exchange, to bring to the occupants of a rather poor soil in middle Europe a necessary supply of food and fibres from other parts of the world, and also a necessary supply of the crude products of the non-machine-using nations for conversion into finished goods for home use and export. In order to celebrate the opening of this peaceful way for commerce, there gathered a collection of naval bulldogs, each for

the time muzzled, but in many instances with growl barely suppressed. In a rough-and-ready way one may estimate the cost of this fleet of one hundred great armor-clad ships of war, with twenty-five lesser vessels, at approximately $200,000,000, which is probably four or five times the cost of the peaceful water-way, the opening of which they were called together to celebrate. The United States was represented by one battle ship and, I believe, by one of our two 'commerce-destroyers,' so called. The two armored ships so named cost nearly $7,000,000—a sum nearly equal to the entire endowment of Harvard University—while the annual expense of keeping the two in commission is nearly as great as the pay roll of the same university. The only commerce of any importance upon which these destructive ships of war could exert their force would be that of Great Britain and Germany, our two largest foreign customers for the excess of our farm products, which would rot upon our fields if we could not sell them for export. Any commentary upon these grotesque conditions would perhaps be superfluous. As time goes on this waste of preparation for war will be stopped in more than one way. First, because no ship can carry armor which will defend it from the latest type of guns. Next, because no land force can stand in the face of guns discharging over six hundred shots per minute, warranted to kill at more than a mile. But lastly, as to European states, because the limit of taxation has been reached. New taxes can not be invented and new sources of revenue can not be discovered which will warrant even the maintenance of existing armies and navies."

Two Wild Vegetables of Merit.—T. W. Card, of the experiment station at Lincoln, Nebraska, calls attention, in *Garden and Forest*, to two wild vegetables which he thinks merit the attention of cultivators.

One of these, which is already gathered from the fields and used to a considerable extent in the West, is the wild lettuce; there are two species common on the plains, *Lactuca canadensis* and *L. Ludoviciana*. They are chiefly used for greens, and fill an important place for this purpose, as they come in advance of spinach, and when no other greens are offered in the market. The other plant is the ground plum or buffalo pea of the plains (*Astragalus crassicarpus*). This is found abundantly in the draws or low grounds of the unbroken prairie. The plant is a perennial, apparently perfectly hardy, and very productive. The fruit resembles gooseberries in size and general appearance. It is borne in numerous clusters, very early in the season. When cooked like string beans the fruit forms a very acceptable dish. The chief point which recommends the plant for cultivation is the time at which the fruits are ready for use, some of them ripening as early as May 7th.

Protecting Iron and Steel against Rust.—Gesner's method, described in *La Revue Scientifique*, consists in forming on the surface of the metal a double carbide of hydrogen and iron. A bar thus coated can be bent through an angle of forty-five degrees without disturbing the layer. The process is as follows: The surface to be coated is first thoroughly cleaned from rust. A couple of gas retorts are placed alongside each other and raised to a temperature of from 600° to 700° C. The articles to be treated are then placed in these retorts for about twenty minutes, after which a current of hydrogen is passed through the retorts for forty-five minutes. A small quantity of naphtha is then introduced, the supply being maintained for ten minutes. It is then stopped, the current of hydrogen being kept up fifteen minutes longer, when it is stopped and the retorts are allowed to cool to 400° C., and when this temperature is reached the doors can be opened and the finished product removed. The coating thus given has a bluish color.

The Microscope in Metallurgy.—Micro-metallography—the examination of samples of iron and steel by looking at etched or polished sections through a microscope—is rapidly taking its place in the routine work of metallurgical laboratories. It has been developed from petrography. Dr. Sorby, an Englishman, who in 1864 submitted some photographs of opaque sections of various kinds of iron and steel to the British Association, seems to have been among the first workers in this field. The process of preparing the specimens is complicated and

somewhat tedious, but the results fully repay the worker. By means of these methods steel has been found to contain five main constituents: Pure iron, *ferrite*; carbide of iron, *cementite*; sorbite, of uncertain composition; *martensite* and *froostite*; the latter marks the transition of soft iron into hardened steel. Sorbite, froostite, and martensite appear to be solidified solutions of various forms of carbon in divers forms of iron, for it seems clear that metallographic work on steel brings into prominence the existence of allotropic forms of iron. An exhaustive monograph on the progress of micro-metallography during the past ten years, by M. F. Osmond, may be found in the *Bulletin de la Société d'Encouragement*, vol. x, p. 480, 1895.

Audibility of Fog-horn Signals.—Some time ago there appeared a description of some experiments which went to prove that around each siren there is a zone, about one and a half nautical miles broad, within which fog signals can not be heard, although they are distinctly heard outside that zone. These statements have been recently confirmed by a series of experiments which are noted in Nature. In one of these the vessel steamed with the wind straight toward the lightship from a distance of four and a half nautical miles. At a distance of two miles and three quarters the sound became faintly audible, and suddenly increased in loudness at two miles and a half, retaining the same intensity up to two miles distance. From one and three quarters to one and a half mile the note was scarcely audible, but then it immediately increased to such an extent that it appeared to originate in the immediate neighborhood of the vessel. The steamer at this point reversed its course, and the fluctuation over this part of the course was found to be the same, except that it was even more strongly marked. The vessel was again reversed, and at half a mile the sound disappeared entirely, to reappear at a quarter of a mile from the lightship; after which it gradually and steadily increased in intensity until the latter was reached.

The Ideals of Modern Medicine.—We take the following from President Sir T. Russell Reynolds's address before the recent meeting of the British Medical Association in London: "The outcome of what I have been saying is this: that the scattered fragments of knowledge and guesses at truth of many years have been gathered into a focus during the past twenty-five years; that the vegetable life extracting from the mineral world the materials it needs for growth and production of powerful agencies for good in the form of food and medicines, and for evil in the form of poisons, has given itself up to the growth of animal life, with its much more complex organs, and for cure of ills once thought beyond the reach of human aid; but that, thanks to man's scientific ardor and industry, it has again shown itself to be our servant, our helper, and our protector. These are not dreams of the study, they are facts of the laboratory and of daily life; and in using that word 'life' again, I must endeavor to emphasize still more forcibly upon you my urgent belief that it is to living agencies and their employment that we must look for help in the care of infancy, the conduct of education—moral, mental, and physical—the training up of character, as well as of limbs; that it is the guidance of living functions, in the choice of living occupations, be they either of hard work or of amusement. It is to these we must appeal if we would see the *mens sana in corpore sano*; and then it will be to these that we may confidently look for help, when the inroads of age or of disease are at hand, often to cure us of our trouble; or if not, to give us rest and peace."

City Government.—The corporation of the city of London is one of the most ancient bodies in England, and its record shows a constant succession of capable men and a uniform policy. It was in existence before Parliament, and it has seen the downfall of more than one royal house. The secret of its success has lain in the fact that municipal dignity has always been confided to the hands of men of business, who had shown their capacity to manage private affairs of great magnitude before they were intrusted with those of their neighbors. Their training had been such as to remove them as far from the hide-bound conservatism of the official as from the destructive reforming energy of the professional politician. As an instance of the methods employed may be

cited the fact that perfect and exact records, with the exception of three years, of every penny spent on London Bridge since 1831 are in existence and in splendid preservation. These facts, which we take from Engineering, differ so extremely from those brought to light by the recent reform investigations in American cities as to seem worthy of notice.

Pithecanthropus Erectus.—At the recent meeting of the zoölogists at Leyden, an interesting discussion occurred over some bone fragments (a femur, the upper part of a skull, and two teeth) upon which Dr. E. Dubois, the naturalist, bases his new species *Pithecanthropus erectus*, an intermediate stage between the anthropoid apes and man. Prof. Virchow contended that the four fragments did not belong to the same animal. Prof. O. C. Marsh was inclined to support many of Dr. Dubois's conclusions. Prof. Rosenberg thought that the peculiarities by which Dr. Dubois made his new species occurred in human bones, and in some few cases all of them combined. Prof. Rosenberg acknowledged, however, the great value of the discoveries, because, even if the bones were human, they proved that Tertiary man existed in Java; the origin of man being thus pushed further back toward the earlier Tertiary period.

MINOR PARAGRAPHS.

The work of the President White School of History and Political Science, which was instituted at Cornell University in 1887 on the gift of his historical library by ex-President A. D. White, naturally falls into the two great divisions suggested by its name. The instruction in history further divides itself into the subdepartments of ancient and mediæval, modern European, and American history; and that in political science into politics, social science and statistics, and political economy and finance. The teaching corps consists of four professors, an associate professor, an assistant professor, an instructor, and an examiner. Five fellowships have been instituted, and degrees are conferred of Master of Arts, of Philosophy, of Letters, or of Science.

The system of tests for the detection of color-blindness described by Dr. William Thomson in The Popular Science Monthly for February, 1885, is used on railroads controlling 38,786 miles of track, and other systems are used on roads controlling 15,579 miles—making 51,793 miles protected. After considerable experience Dr. Thomson proposes some improvements to be used in connection with his color-stick or as a substitute for it. The new test consists of a large green and a large rose test skein, and forty small skeins, each marked with a concealed number. The stick is dispensed with, because it gives a too fixed arrangement and not enough confusion. One of the test skeins being laid out, the candidate is directed to select, from the twenty skeins of similar color exposed with it, those having the shades nearest to it; and the accuracy of his vision is determined by the exactness of his selection and his avoidance of the confusion skeins. The red test skein and its confusion colors are omitted.

The Russian thistle, the latest imported agricultural pest, is described in a bulletin of the University of Illinois Agricultural Experiment Station as not a thistle nor looking like one, but as a tumbleweed. When mature, its stems are more woody than those of ordinary tumbleweeds, and the spines or little thorns are hard. Sometimes the plants are compact, nearly round; sometimes, when growing close together, they fail to have the rounded form. They may be one, two, or three feet high, and from eighteen inches to six feet across. The leaves, flowers, and seeds are very small. In the later summer the stems have a purple or rose color. The seeds mature after the first of September. The plants and seeds should be destroyed by burning. A bulletin of the Ohio Agricultural Experiment Station on this subject contains some useful remarks on weeds in general.

The Massachusetts Agricultural College at Amherst had in 1894 the largest number of students and the largest graduating class in its history. Gratifying results followed the introduction of the elective system in the studies of the senior year, which were shown

somewhat tedious, but the results fully repay the worker. By means of these methods steel has been found to contain five main constituents: Pure iron, *ferrite*; carbide of iron, *cementite*; sorbite, of uncertain composition; *martensite* and *froostite*; the latter marks the transition of soft iron into hardened steel. Sorbite, froostite, and martensite appear to be solidified solutions of various forms of carbon in divers forms of iron, for it seems clear that metallographic work on steel brings into prominence the existence of allotropic forms of iron. An exhaustive monograph on the progress of micro-metallography during the past ten years, by M. F. Osmond, may be found in the *Bulletin de la Société d'Encouragement*, vol. x, p. 480, 1895.

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The Ideals of Modern Medicine.—We take the following from President Sir T. Russell Reynolds's address before the recent meeting of the British Medical Association in London: "The outcome of what I have been saying is this: that the scattered fragments of knowledge and guesses at truth of many years have been gathered into a focus during the past twenty-five years; that the vegetable life extracting from the mineral world the materials it needs for growth and production of powerful agencies for good in the form of food and medicines, and for evil in the form of poisons, has given itself up to the growth of animal life, with its much more complex organs, and for cure of ills once thought beyond the reach of human aid; but that, thanks to man's scientific ardor and industry, it has again shown itself to be our servant, our helper, and our protector. These are not dreams of the study, they are facts of the laboratory and of daily life; and in using that word 'life' again, I must endeavor to emphasize still more forcibly upon you my urgent belief that it is to living agencies and their employment that we must look for help in the care of infancy, the conduct of education—moral, mental, and physical—the training up of character, as well as of limbs; that it is the guidance of living functions, in the choice of living occupations, be they either of hard work or of amusement. It is to these we must appeal if we would see the *mens sana in corpore sano*; and then it will be to these that we may confidently look for help, when the inroads of age or of disease are at hand, often to cure us of our trouble; or if not, to give us rest and peace."

City Government.—The corporation of the city of London is one of the most ancient bodies in England, and its record shows a constant succession of capable men and a uniform policy. It was in existence before Parliament, and it has seen the downfall of more than one royal house. The secret of its success has lain in the fact that municipal dignity has always been confided to the hands of men of business, who had shown their capacity to manage private affairs of great magnitude before they were intrusted with those of their neighbors. Their training had been such as to remove them as far from the hide-bound conservatism of the official as from the destructive reforming energy of the professional politician. As an instance of the methods employed may be

cited the fact that perfect and exact records, with the exception of three years, of every penny spent on London Bridge since 1831 are in existence and in splendid preservation. These facts, which we take from Engineering, differ so extremely from those brought to light by the recent reform investigations in American cities as to seem worthy of notice.

Pithecanthropus Erectus.—At the recent meeting of the zoölogists at Leyden, an interesting discussion occurred over some bone fragments (a femur, the upper part of a skull, and two teeth) upon which Dr. E. Dubois, the naturalist, bases his new species *Pithecanthropus erectus*, an intermediate stage between the anthropoid apes and man. Prof. Virchow contended that the four fragments did not belong to the same animal. Prof. O. C. Marsh was inclined to support many of Dr. Dubois's conclusions. Prof. Rosenberg thought that the peculiarities by which Dr. Dubois made his new species occurred in human bones, and in some few cases all of them combined. Prof. Rosenberg acknowledged, however, the great value of the discoveries, because, even if the bones were human, they proved that Tertiary man existed in Java; the origin of man being thus pushed further back toward the earlier Tertiary period.

MINOR PARAGRAPHS.

The work of the President White School of History and Political Science, which was instituted at Cornell University in 1887 on the gift of his historical library by ex-President A. D. White, naturally falls into the two great divisions suggested by its name. The instruction in history further divides itself into the subdepartments of ancient and mediæval, modern European, and American history; and that in political science into politics, social science and statistics, and political economy and finance. The teaching corps consists of four professors, an associate professor, an assistant professor, an instructor, and an examiner. Five fellowships have been instituted, and degrees are conferred of Master of Arts, of Philosophy, of Letters, or of Science.

The system of tests for the detection of color-blindness described by Dr. William Thomson in The Popular Science Monthly for February, 1885, is used on railroads controlling 38,786 miles of track, and other systems are used on roads controlling 15,579 miles—making 51,793 miles protected. After considerable experience Dr. Thomson proposes some improvements to be used in connection with his color-stick or as a substitute for it. The new test consists of a large green and a large rose test skein, and forty small skeins, each marked with a concealed number. The stick is dispensed with, because it gives a too fixed arrangement and not enough confusion. One of the test skeins being laid out, the candidate is directed to select, from the twenty skeins of similar color exposed with it, those having the shades nearest to it; and the accuracy of his vision is determined by the exactness of his selection and his avoidance of the confusion skeins. The red test skein and its confusion colors are omitted.

The Russian thistle, the latest imported agricultural pest, is described in a bulletin of the University of Illinois Agricultural Experiment Station as not a thistle nor looking like one, but as a tumbleweed. When mature, its stems are more woody than those of ordinary tumbleweeds, and the spines or little thorns are hard. Sometimes the plants are compact, nearly round; sometimes, when growing close together, they fail to have the rounded form. They may be one, two, or three feet high, and from eighteen inches to six feet across. The leaves, flowers, and seeds are very small. In the later summer the stems have a purple or rose color. The seeds mature after the first of September. The plants and seeds should be destroyed by burning. A bulletin of the Ohio Agricultural Experiment Station on this subject contains some useful remarks on weeds in general.

The Massachusetts Agricultural College at Amherst had in 1894 the largest number of students and the largest graduating class in its history. Gratifying results followed the introduction of the elective system in the studies of the senior year, which were shown

in increased interest in study that was communicated also to the other classes. Courses of lectures were delivered by Sir Henry Gilbert, Dr. B. E. Fernow, and Major Henry E. Alvord. The museum has been arranged so as to present a systematic view of the entire animal kingdom, with especial regard to the fauna of Massachusetts. Models of the horse, cow, sheep, pig, and dog, and their organs, have been supplied in the veterinary department, and pathological specimens. It is proposed to devote a part of the grounds of the college to the growth of the trees and plants of Massachusetts.

A SUMMARY of the lectures announced for the last summer semester at the German universities is interpreted by Charles N. Judd, in Science, as indicating that logic and the theory of knowledge are absorbing much more attention than any form of speculative metaphysics. Sixteen courses in the nineteen universities are devoted to these subjects. Work is also being done in many places in laboratories and seminaries. Five courses, besides the seminary work, are given on Kant's system. The historical work covers all periods, beginning with Prof. Deussen's investigations in old Sanskrit and Greek philosophy, and extending to the philosophy of to-day.

NOTES.

THE sudden disappearance of streams in limestone countries, sometimes to reappear at the surface farther on, is not uncommon. In Yorkshire, England, there are many such streams. The points where they disappear are called "pots." One of the largest of these pots, "Gaping Ghyll," was recently explored by M. Martel of Paris. The stream being temporarily diverted, M. Martel descended by means of a series of rope ladders. He took with him a telephone and a supply of candles. He reached bottom at three hundred and thirty feet, and found a vast chamber about four hundred and fifty feet in length, one hundred and twenty feet in breadth, and ninety to one hundred feet in height.

A MEETING of the friends and admirers of Mr. Huxley, under the chairmanship of Lord Kelvin, was recently held at the rooms of the Royal Society to consider a national memorial. It was decided to call a general public meeting in the fall. Sir John Lubbock (15 Lombard Street) will act as treasurer. At a recent meeting held at the Charing Cross Hospital Medical School, from which Mr. Huxley received his M. D., the following resolution was passed: That there be a memorial in the form of a Huxley scholarship and medal to be awarded annually at the Charing Cross Hospital Medical School, and that, if funds permit, an annual public lecture dealing with recent advances in science and their bearing upon medicine shall be instituted.

A SHORT time ago, in the theater of King's College Hospital, London, Sir Joseph Lister was presented with a three-quarter length portrait of himself, painted by Mr. Lorimer, A. R. S. A., and also an illuminated and illustrated album containing the names of the subscribers. Dr. W. S. Playfair, who presided, said that the testimonial was simply an offering from his old friends, colleagues, and pupils, as a token of the affection and esteem which they entertained for him.

DR. E. H. WILSON, bacteriologist of the Brooklyn City Board of Health, recently made some investigations relative to the bacterial content of graveyard soils. He states that the soil of cemeteries contains no more bacteria than the soil of other places; that he found no pathogenic bacteria in the examined soil; and that those which he did find were such as engage in the destructive decomposition of the body, and were hence beneficent instead of harmful.

MR. JOSEPH THOMSON, the African traveler, who died in London early in August, though not yet forty years old, was one of the most successful and most famous of the explorers of the dark continent. He first went out on the Keith Johnson expedition to the Great Lakes, and on the death of its leader took charge and accomplished its objects. He next had charge of an expedition to Masailand in 1883 and 1884, where he showed admirable tact in dealing with the savage natives and made important discoveries. He afterward negotiated treaties in Sokoto, explored the Atlas Mountains in Morocco, and in 1891 explored the region between Lake Nyassa and Lake Bangweolo. All these things he accomplished without bloodshed. He was the author of three books describing his explorations, of a Life of Mungo Park, and of Ulu, a romance illustrative of life in East Africa.

DR. JOSEPH GRANVILLE NORWOOD, who died in Columbia, Mo., May 5th, was engaged in the Geological Survey of Wisconsin, Iowa, and Minnesota, under D. D. Owen, from 1847 to 1851, exploring chiefly the region about Lake Superior; was afterward State Geologist of Illinois, and Assistant Geologist of Missouri, and was from 1860 to 1880 a professor in the University of Missouri. He retired in 1880 as professor emeritus, on account of ill health. In 1847 he described and figured the *Macropetalichthys rapheidolabis* of the Devonian of Indiana—the first fossil fish described in the United States. He was author of some geological reports and several monographs.